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Memoir on the Discovery of a Factitious Puzzolana, presented to the French National Institute, by M. DODUN, *Engineer in Chief of Bridges and Highways in France.**

THE deposited dust of ancient volcanic substances, has been long used in Flanders, and the adjacent countries, as a substitute for the Italian puzzolana, under the name of *trass*, or *ashes of Tournai*.

M. Faujas has proved by decisive experiments, made by order of government, that certain lutulent eruptions of ancient volcanoes at Vivarais, had the same qualities as the puzzolana of Italy, and might be used instead of it. M. Bagge, a Swede, is also known to have composed an artificial puzzolana cement, with a black, hard, and slatey schist; but until 1787, no one ever thought that the territory of France contained in abundance non-volcanic substances capable of taking place of the Italian puzzolana with economy and advantage.

* Nicholson, vol. 12, p. 331. From the *Journal de Physique*, tom. 61.

The discovery which I here present, has, like many others of great utility, been the effect of chance.

The habit of examining the nature of stone in its bed, which enables the observer to judge of its qualities at first sight, fixed my attention on an immense quantity of calciform fragments of iron ore, in beds of from eight to ten feet thickness, following exactly the parallelism of the slightly inclined declivities, in the neighbourhood of Castlenaudery. I perceived in the adjacent fields many substances of the same nature scattered over the surface of the earth, of violet, brown, and black colours, which from their appearance, had a perfect resemblance to compact lava, which seemed extraordinary in a country where there was no appearance of ancient craters, or of volcanic eruptions. These I soon found out had been brought to this state by serving as hearths, or enclosures to the fires kindled in the fields by the peasants, either for agricultural purposes, or personal convenience when they watch their flocks in winter; as I saw soon after, many similar arranged by hand on one another for these purposes.

The similarity of these fragments to volcanic products excited my desire to form a cement from them, by treating them in the same manner as puzzolana earth. The great quantity of iron which these oxides seemed to me to contain, the abundance of their siliceous particles, and the alumen which evidently entered into their composition, their great weight, and their non-effervescence with acids, altogether made me presume, that the cement formed from them would bind under water, and my expectation was not deceived.

Fifteen months successive experiments, to discover the proportion of lime which this oxide would absorb to harden in water, without cracking when in the air, have convinced me, that my factitious puzzolana had all the good

properties of that of Italy, without its faults. At this time I determined to propose its use in the public works, and demanded that comparative experiments should be made between it and the Italian puzzolana, in presence of the commissaries of the province of Languedoc, and of the directors of the canal which joins the two seas. Great blocks of *Beton* composition made with both cements, were thrown into the reservoirs adjacent to the lock of Saint Roch, at Castlemandery, being first plaistered over with the respective compositions.

Six months after, the water was drawn off from the bodies of masonry, and it was then seen that the factitious puzzolana had acquired a solidity at least equal to that of Italy. The plaister made with the Italian puzzolana was cracked and chapped, but that formed from the factitious kind had entirely preserved the unity of its surface.

The states of *Etats* of Languedoc altogether convinced of the authenticity of this discovery, by the results of the comparative trials of both kinds of cement which they had seen, and by the certificates of their commissaries, and persuaded of the great advantage it would be to France, decreed in 1789, in their last meeting, that the factitious puzzolana should not only be used instead of the Italian in the works under their direction; but moreover, that it should be demanded in favour of the author of it, as a testimony of public gratitude, that government should authorize the free circulation of it every where.

The great consumption of this factitious puzzolana obliged me to extend its manufacture, I formed a partnership with the proprietor of the ground. The foundation of an establishment on a great scale was laid at the mountain itself where the materials were found. The works carried on in its vicinity were likely to farther re-

duce the cost of the article, which was already one half less than that of Italy, and the public were about to enjoy the advantages of this manufacture, when the revolution paralysed every thing.

In 1791 I informed the constituent assembly of this discovery; the certificates which proved it, and the results of the experiments were deposited at the office; the matter was ordered to be examined by M. M. Pelletier and Berthollet, and the assembly considering, that this factitious puzzolana might be of the greatest use to France, decreed that two thousand francs should be granted to its author, which were paid accordingly.

On this occasion the celebrated Mirabeau declared the discovery to be so valuable, "*that if it had not yet been made, public encouragement should be held out to excite it.*"

The Constituent Assembly wished to have numerous similar establishments set on foot in France, so well were they convinced of its national importance; but the misfortunes of the times prevented the execution of a project, which the grand chief of the empire may easily realize, to the advantage of the country, whenever it seems good to him to do so.

Researches on the amelioration of our cements, and particularly on the nature of the materials proper to form artificial puzzolana, led me to try the calcination of various schists, of the bitumenous, ferruginous, and argillaceous sorts.

The black slatey schist of M. Bragge, so common in France, was not forgotten: It is almost the same as that which the elder M. Grathieu essayed at Cherboug last year; but I have constantly found that these schists always contain too little iron. I perceived that their repulsion of the water was slow and feeble, and that their

solidification in the water was owing to the good quality of the lime.

I was thus obliged to recur to my quartzose oxides of iron, from their containing a greater quantity of ferruginous principles; and can aver with the skilful Faujas, that the puzzolanas owe their property of hardening in water solely to the ferruginous particles which they contain: of this I have had many proofs. This truth is farther demonstrated in the pudding-stones, the brescias, and generally in all the amygdaloides with a ferruginous base or cement.

The theory of our cements is but little advanced; perhaps we take simple conjectures for proofs relative to them. We effect the regeneration of silex, and of the carbonate of lime; we know the acid gases which perform the principal part in the affair: but in this important work we have been long ignorant of the degrees of their reciprocal affinity, their quantity, and the mode of their respective combinations. Our knowledge on this matter is confined to a few facts.

Many experiments have proved to me that the puzzolana, which soonest forms a body in the water, is not fit to be employed in the open air, where it cracks and chaps in all directions. And that which is proper for the air, and which acquires and preserves its tenacity in it, sets but imperfectly in water. This difficulty, of which the Institute will perceive the cause, has obliged me to keep two sorts of the factitious puzzolana; on the reciprocal use of which a memoir of instruction will accompany the sale. The two sorts may be distinguished by their colour.

The factitious puzzolana proper for works under water, is of a reddish-brown. That which is fit for works exposed to the air, is a dark violet. The latter is used for terraces, the embankments of basons, for the com-

position of inclosures, or for light roofs. Bridges of a single arch may be formed with it; and I have seen it adhere so strongly to glazed tiles, that it was necessary to break the tiles to detach it.

The puzzolana proper for constructions beneath the water, forms the most solid body in it. Three months after immersion it is an actual stone capable of receiving a polish. The lime in it is always regenerated into carbonate of lime in ten weeks.

When it may be thought by any one that he has been deceived as to the certainty of these effects, it will always be found, that he either has not observed the quantities directed of the puzzolana and the lime, or that he has used the reverse of that kind of the cement proper for the work.

I commonly used lime in the state of impalpable powder, slacked in Lafaye's manner, for works exposed to the air; and employed lime in the state of *putty*, for works which were to be covered with water. Sometimes I used lime in powder for the same work. This difference depends on the degree of goodness of the lime, on its greater or lesser richness, or its proportional poverty. Custom gives the advantage of knowing the different kinds on mere inspection.

The use of lime in powder appeared to me to merit a preference in the preparation of mortars or cements. I prepared my factitious puzzolana in a certain quantity as soon as I knew the proper proportion of the lime; and I had thus the advantage of being able to work it in troughs in the same manner as sulphate of lime. The whole was well mixed together and put into sacks; by which means the masons had nothing to do with the mixture of the articles, (which is too often left to unprincipled workmen,) and being thus master of the respective

proportions of the puzzolana and the lime, I could always be assured of the solidity of my cements.

There remains for me to describe the exterior characters of the quartziferous ferruginous oxides, which form the basis of my factitious puzzolana, and to relate the analysis of them which I made about eighteen years ago. I will content myself with offering the comparative results with the Italian puzzolana, both in the dry way and the moist.

Exterior Characters of the quartziferous Oxides of Iron.

Their colour is of a reddish-brown before calcination, or slightly violet. A light torrification gives them a clearer red tint or a deep violet: one more intense renders them of a deep brown or of a violet-brown inclining to a black. The degree of the calcination for use is confined to those two states.

Urged at a longer continued heat, the colour becomes a deep black; then the substance becomes porous, entirely similar to certain lavas of our modern or ancient volcanoes, with which it is then difficult not to confound them.

Their fracture is grained and a little earthy, and small crystals of quartz may be distinguished in them by the naked eye, and almost always angular fragments of gray or milky quartz; a powerful magnifying lens causes in some fragments the discovery of needles of schorl, the amphibole of Hauy, and some small tourmalines.

Their smell is strongly argillaceous on breathing on them with the mouth.

There is no fire produced by the use of the steel, when it does not strike a quartzose particle.

They do not effervesce with acids either cold or hot.

The magnet acts a little on these oxides before calcination, and strongly, or perceptibly, after it.

The medium weight of a cubic foot is one hundred and twenty-five degrees; that of the Italian puzzolana is but ninety-one degrees.

Analysis by the moist Way.

I SHALL not weary the assembly by a detail of the manipulations relative to the solvents and re-agents which art uses for the decomposition of bodies, and shall only say, that silex, iron, alumen, and a small portion of manganese, are the constituent parts of these oxides.

I repeated these experiments many times, and had for a medium result from an hundred pounds, chemical weight,

50 parts of silex;
31 —— of iron;
16 —— of alumen;
3 —— of manganese, and loss.

100

If this analysis be compared with that of the puzzolana of Italy, which contains in 100 parts—

50 of silex;
25 of alumen;
16 of iron;
3 of lime;
6 of loss;

100

their respective properties may be appreciated according to the proportions of their integrant parts.

The excess of alumen causes the plaisters made from the Italian puzzolana to crack and chap in the open air: this fault arises from their great oxidation. I have been able to replace in them those principles which they lost by decomposition.

Analysis in the dry Way.

I ENDEAVOURED to obtain a regulus from these oxides of iron by using a violent heat. I followed the process of Kirwan for the fusion of siliceous and argillaceous ores of iron; yet I never obtained a single metallic button; and only found at the bottom of the crucible a vitrified mass of an opaque black, or a scoria in the state of crude cast iron.

Desirous to know if I could procure a malleable button by using the blowpipe, taking borax for the flux and supporting the oxide on charcoal; I still could only obtain a spongy ingot resembling crude cast iron, and breaking both when hot and when cold.

Being placed on a support of glass, (according to my method published in the Journal de Physique, tome 31, pages 116 and 139,) the oxide fused at the second attempt, the support was coloured green, and small grains of iron were seen to pass first of a dark-green colour, then of a bright green, and afterwards to disappear in evaporating. There remained on the globule only a slight tinge of blackish-green.

The result of all these facts seems to be, that this oxide is entirely deprived of its metallic principle, and that its super-oxigenation renders it reducible and refractory.

The arts may draw some advantage from these oxides, by using them in pigments for buildings. I succeeded after many washings, in extracting from them a beautiful

brown-red colour equal to that of commerce, and applied it to use successfully.*

No. 49.

Report made to the Institute on two Memoirs of M. Gratien Lepere, *on natural and artificial Puzzolana. By M.* Chaptal.†

EVERY person is acquainted with the purposes to which puzzolana is applied in buildings under water. The property possessed by this volcanic substance of speedily becoming hard when mixed with sour lime, in the composition of cements for hydraulic purposes, has

* This paper has been abridged in its introduction, in the details relative to negociations with the Constituent Assembly, and in some other points a little irrelevant to the puzzolana; but all matters directly tending to illustrate its nature and properties have been carefully copied.

M. Dodun's discovery may be of some use to this country, as there are in many parts of it large masses of iron-stone, and some is found in the vicinity of most coal-mines.

It has been long known that iron ochres have the same property of forming puzzolana with lime, when properly roasted, and this circumstance is mentioned at large in Chaptal's Chemistry. A patent has also been obtained in this country for the application of iron pyrites to the same purpose, the right to which was purchased long ago by Mr. Samuel Wyat. But the novelty of M. Dodun's discovery is, that poor iron-stone is equally fit for this use, as the other substances mentioned, which is of the more importance as it is very plentiful, and may often be procured in situations where the others cannot.

It may not be amiss to mention here, that basalt treated in the same manner, has the same property as the púzzolana: the whinstone, of which the ovoidal paving-stones consist mostly, is of this kind; and it is found in great abundance in these countries, in different forms.—B.

*** It may not be amiss to ascertain by experiment, whether the slag of the blacksmith's forge, which contains a considerable proportion of oxided iron, will not, with a due proportion of lime and sand, form a factitious puzzolana, equal to any we obtain from abroad. If this should be the case, as, from some few slight experiments I am disposed to believe, we shall always have, in every situation, ample materials for this important matter.—Coxe.

† Tilloch, vol. 34, p 178. From the *Annales de Chimie*, tome 64, p. 273.

rendered it a most important article; but the difficulty of procuring it from Italy while the navigation of the seas is interrupted, has made it extremely scarce and dear. Attempts have therefore frequently been made to procure a substitute for puzzolana, in substances which are to be procured in all countries and at a low price.

It seems, therefore, an interesting subject to collect the various processes which have been employed for adapting different mineral substances to the uses of puzzolana, and with this view I have drawn up the present extract of M. Lepere's two memoirs, without binding myself to follow his order.

A substitute for puzzolana may be procured in three ways. 1st, By employing the remains of the extinguished volcanoes which almost all countries produce. 2dly, By substituting some other volcanic products for puzzolana. 3dly, By giving to certain mineral substances, by calcination, all the properties of these volcanic productions.

Messrs. Desmarets and Faujas Saint Fond long ago made known some strata of good puzzolana in the volcanoes of Auvergne and Vivarais. I also pointed out this substance in the volcanoes which separate Lodeve from Bedarieux, in the department of the Herault, and it has been employed with success in the construction of bridges and other hydraulic buildings.

We may also find a substitute for puzzolana in other volcanic products, such as basalt, pumice stones carefully pounded, &c.

In 1787 M. Guyton de Morveau sent to M. de Cessart, at Cherbourg, some calcined basalts from the extinguished volcano of Drevin, in the department of the Var and Loire. The latter proved by conclusive experi-

ments, that they might be employed with great advantage in buildings under water.

The Dutch terrass is a kind of pumice stone brought from Bonn and Andernach. At Dordrecht, at the mouths of the Rhine and Meuse, the operation of pounding is effected.

But these resources are local; and as the manufacture of puzzolana may become general, we proceed to describe the best means of attaining it.

It would be difficult to assign the period at which pounded bricks and the earthy residue from the distillation of aquafortis were substituted for volcanic puzzolana. Their use, however, has become general, particularly where there are no sea-ports in the vicinity at which real puzzolana can be furnished: even in the south of France they prefer the earthy residue of the distillation of aquafortis to the best puzzolanas for coating the inside of the wine tubs, which are almost all of mason work, and for the cements used by individuals in hydraulic works. The earth employed in the south of France for the decomposition of saltpetre, by extracting the aquafortis from it, is an ochrey earth very much charged with iron, and more or less reddened by the oxide of this metal. When it is wanted for cement, it is only necessary to beat it up with lime and a proper quantity of water. M. Lepere relates some experiments made at Paris by the engineers of roads and bridges, from which it appears that an immersion of eight days was sufficient for aquafortis cements to acquire a hardness fit to resist a billet of wood when forced against it with the whole strength of a man; whereas the Italian puzzolana required six weeks before it attained the same degree of hardness.

In general the quality of the earth is better in proportion as it is charged with iron.

This last observation is equally applicable to pounded bricks: in general they do not make a good cement unless they are well burnt, and made of very ferruginous earth.

Twenty years ago I suggested the above substitutes for puzzolana; and the result of my comparative trials made in the port of Cette, under the inspection of the engineers of the province of Languedoc, was published in 1787, in a memoir printed by Didot, by order of the states-general of the province.

The means which I suggested for making this artificial puzzolana are simple, and may be put in practice almost every where. Balls should be made of the ochrey earth, and burned in a lime or potter's kiln. In order to form these balls, the earth must be moistened with a sufficient quantity of water; and when the balls are made, they should be burned until they pass from a red to a black colour, and the angles of the scales formed when they are broken exhibit sharp and shining edges.

In the same work I proposed to substitute the blackish schists which are decomposed in the air for puzzolanas. Those which are in cakes are best; but in all cases they must be strongly calcined, in order to give them the requisite properties.

M. Lepere relates that M. Vitalis, professor of chemistry and secretary to the Rouen Academy, and M. Lamassen, chief engineer of the department of the Lower Seine, have made most excellent puzzolana by the calcination of some ochrey earths in the environs of Rouen: this was effected by burning the earth in a common furnace with alternate strata of common charcoal. This puzzolana was subjected to some trials on a large scale, and it was composed in the following manner:

One part and a half of yellow calcined ochrey earth

One part and three-fourths of well washed siliceous sand.

One part and an eighth of sour lime.

Two parts of chips from calcareous stone and silex.

From these and several other experiments (the proportions of which were varied) it results, that the artificial puzzolana constantly exhibited the same effects as the best puzzolana of Italy. M. Lepere was an eye-witness of all these comparative experiments.

There can be no doubt, therefore, that wherever there are ochrey earths, artificial puzzolana may be made with great facility.

What is called Dutch terrass is in many respects similar to the artificial puzzolana in question.

The ashes, or rather scoriæ, left when coals are burnt, may also be applied to the same purpose. M. Guyton caused a trial to be made at Cherbourg, and it succeeded well.

M. Gratien Lepere, having been intrusted in 1804 with constructing the foundation of the new arsenal at Cherbourg, began to turn his attention to the best method of supplying the puzzolana of Italy. He knew that the Swedes had already used a very hard black slate with this view, after being twice strongly calcined in a lime-kiln.

M. Lepere thought he perceived a great analogy between the Swedish stone and the rocks of Cherbourg, particularly those of port Bonaparte, which, when dug into, exhibited a black schistus, hard, ferruginous, and falling off in scales of various thickness: subsequent experiments, however, proved that the slaty schistus of Roule, in the environs of Cherbourg, is preferable, and that good mortar may be made with the ferruginous schist of Haineville, which is inferior, however, to the two former.

After having multiplied and varied his experiments in such a manner as to present positive results, M. Lepere, in conjunction with the committee of engineers appointed to examine his experiments, draws the following conclusions:

1st. That the schist of Cherbourg, when strongly calcined and pulverised, forms an excellent mortar when mixed with sour lime.

2dly. That in order to give precisely the same properties to schist which are possessed by puzzolana and terrass, the former must be calcined in a reverberating, instead of a lime, furnace.

No. 50.

Description of a very simple and useful Scale, for dividing the vanishing Lines in Perspective. In a Letter from G. CUMBERLAND, *Esquire, to Mr.* NICHOLSON.*

(With an engraving.)

SIR—Having been in the habit of drawing for my amusement all my life, and feeling the value of that acquirement, it has been my practice to recommend to others as much of that acquisition as can with very little trouble be attained; I mean the putting into perspective common objects; such as simple landscapes, machines, buildings, and the interior of apartments, manufactories, &c. And where I have had an opportunity to give four or five close lessons, I have generally seen my end obtained to their great satisfaction, without ever showing them the *Jesuits*, or any other voluminous treatise; books that have hindered more the study of art, than they have ever made artists; for a moment's consideration on this

* Nicholson, vol. 16, p. 1.

subject will convince any mind, capable of reflection, that, to accomplish the general ends that even most painters have in view with respect to that art, it is only necessary to know the use of *the points of sight and horizontal line.* For while men have agreed to avoid bevel lines in all their constructions that are intended for use or habitation, we shall only want as much knowledge of the art as will enable us to put these into perspective, and to assist us at first, before, by practice, we have attained a correct eye; for practice, daily practice, will soon do all the rest, even by barely drawing the interior of a large apartment or gallery, with the objects continually before us in common use.

To save time, however, and to imprint the few lessons necessary to be given on the mind of a learner, I have, some time back, made use of the following simple contrivance, which I now send to you, as the most likely means of universally promoting this necessary preliminary study, where the first general principles have been instilled:—Take a sheet of paper of an octavo size, and rule it with very black ink, from A to B (fig. 1, plate 7). This represents the horizontal line; then fix a point in the centre, at C; this we will call the moveable point of sight: afterwards cross it, as in the plate, with as many diagonal lines as you please; and thus you have an instrument prepared that will be a sure guide to an inexperienced eye, in taking the perspective lines of all objects placed at right angles; such as streets, buildings, churches, apartments, &c. by merely placing it under the leaf you mean to draw them on from nature, so as to see them faintly through, as boys do their writing-copies, when young and inexperienced.

But, to make this instrument more complete, we should add a plate of glass of the same size as the leaf of the drawing-book, on which the like dark lines should be

drawn so as, by holding it up perpendicularly, we may see, and, as it were, render tangible, the truth of perspective lines of buildings; and for those whose sight is bad, or for very young people, it would not be amiss to take a copper-plate of the like dimensions, and with a fine needle gently scratch out the like lines, in which case there will be no necessity to take off the burrs, as the engravers, call the ridges raised in ploughing copper; and from this plate, *ten thousand* impressions may be taken of the faint lines by way of guide, on the drawing-book of a young beginner, without injuring the plate; for I can assure your readers, that it is more difficult to erase a slight scratch from a sharp needle on copper, by the act of taking impressions, than the deepest cut of the graver; the reason of which is, that the ridges of the skin of the printer's hand can never enter that fine line, whereas, in a coarse one, he polishes the edges of it down by every operation, and thus renders it a smooth channel, at last undefined, and incapable of retaining the printing ink; and the reason I am so diffuse on the subject is, that I think the knowledge of it may be generally useful, particularly to those who wish to extend the publication of botanical outlines: as it is not necessary to be taught the art of engraving for those who can draw lines, to design on copper the peculiarities of plants, or their anatomy. How to trace deeper lines with certainty on copper as easily as on paper, I will have the pleasure to communicate to you at my next leisure moment.

But, to return to our subject.

To this simple contrivance, we may add a sheet of perpendicular lines, by which means the uprights will all be shown; and for very heavy intellects, at first even the horizontal scale might be useful, though I never found it so among my acquaintance. There are also many little helps of simple contrivances to further the first acquire-

ment of this plain branch of the art; that, if you approve the idea, I shall with pleasure transfer from my portfolio: but with respect to the application of this already described, it will be necessary to premise, that the scale should be longer than the drawing-book each way; by which means, by barely sliding it to the right or left, you can at pleasure place your point of sight more or less to the right, or left, or middle of the horizon; and, to be prepared for all circumstances, it would be as well to be provided also with a scale having a high horizon, and another with a very low one, such as the Dutch painters generally used, and which ever produces a picturesque effect, by giving many profiles of the elevations, and multiplying the lines of light.

Thus you have an easy expedient for a first help—practice will accomplish the rest; for we all know, or should know, that daily practice discloses to the industrious draftsman all the arcana of optical, aereal, and linear perspective, destitute, it is true, of terms to describe his acquirement; but to his own mind a perfectly intelligible and useful rule, by the help of which he can, with certainty, imitate all he sees on the theatre of the universe. I am, &c.

GEORGE CUMBERLAND.

Bristol, December 4, 1806.

NO. 51.

Description of a Cheap, Simple, and Portable Instrument, for determining the Positions of Objects in taking a Picture from the Life. By R. L. EDGEWORTH, *Esquire.**

(With an engraving.)

THAT active and intelligent philosopher and journalist, citizen Pictet, author of the Bibliotheque Brit-

* Nicholson, vol. 1, p. 281.

tanique, on his late return from London to Paris, presented various instruments brought from this country to the National Institute of France. Among them was the instrument here to be described, and since published in the Bulletin des Sciences; on inspection of which my attention was excited to my notes, where, among other communications to be made to my readers, I find this instrument, as published in the excellent work "On Practical Education," by Maria Edgeworth and her father, to whom I have ascribed the contrivance in the title. The authors of the Bulletin affirm, that it was invented and executed by the children under the parental care of Miss Edgeworth; but I find no such intimation in the original work. The instrument of professor Pictet is in various respects inferior to that which I have here copied; insomuch that citizen Cloquet has proposed an amendment, for giving the index an horizontal position when it is required to transfer the observation to paper, which is in fact less effectual than the provisions made for that purpose, and for fixing the true instrument. After this preface, I shall proceed to copy without farther remark, page 460.

"An early use of a rule and pencil, and easy access to prints of machines, of architecture, and of implements of trades, are of obvious use in this part of education (mechanics). The machines published by the Society of Arts in London, the prints in Desaguliers, Emerson, le Spectacle de la Nature, Machines approuvées par l'Académie, Chambers's Dictionary, Berthoud sur l'Horlogerie, Dictionaire des Arts et des Metiers, may in succession, be put into the hands of children. The most simple should be first selected, and the pupils should be accustomed to attend minutely to one print before another is given to them. A proper person should carefully point

out and explain to them the first prints that they examine; they may afterwards be left to themselves.

"To understand prints of machines, a previous knowledge of what is meant by an elevation, a profile, a section, a perspective view, and a (*vue d'oiseau*) bird's eye view, is necessary. To obtain distinct ideas of sections, a few models of common furniture, as chests of drawers, bellows, grates, &c. may be provided, and cut asunder in different directions. Children easily comprehend this part of drawing, and its uses, which may be pointed out in books of architecture; its application to the common business of life is so various and immediate, as to fix it for ever in the memory; besides, the habit of abstraction, which is acquired by drawing the sections of complicated architecture or machinery, is highly advantageous to the mind. The parts which we wish to express are concealed, and are suggested partly by the elevation or profile of the figure, and partly by the connection between the end proposed in the construction of the building, machine, &c. and the means which are adapted to effect it.

"A knowledge of perspective is to be acquired by an operation of the mind, directly opposite to what is necessary in delineating the sections of bodies; the mind must here be intent only upon the objects that are delineated upon the retina, exactly what we see; it must forget or suspend the knowledge it has acquired from experience, and must see with the eye of childhood no farther than the surface. Every person who is accustomed to draw in perspective, sees external nature, when he pleases, merely as a picture: this habit contributes much to form a taste for the fine arts; it may, however, be carried to excess. There are improvers who prefer the most dreary ruin to an elegant and convenient mansion, and who prefer a blasted stump to the glorious foliage of the oak.

"Perspective is not, however, recommended merely as a means of improving the taste, but as it is useful in facilitating the knowledge of mechanics. When once children are familiarly acquainted with perspective, and with the representations of machines by elevations, sections, &c. prints will supply them with an extensive variety of information; and when they see real machines, their structure and use will be easily comprehended. The noise, the seeming confusion, and the size of several machines, make it difficult to comprehend, and combine their various parts, without much time, and repeated examination; the reduced size of prints lays the whole at once before the eye, and tends to facilitate not only comprehension, but contrivance. Whoever can delineate progressively as he invents, saves much labour, much time, and the hazard of confusion. Various contrivances have been employed to facilitate drawing in perspective, as may be seen in "Cabinet de Servier, Memoirs of the French Academy, Philosophical Transactions, and lately in the Repertory of Arts." The following is simple, cheap, and portable.

"Plate 7, fig. 2, A, B, C, represent three mahogany boards, two, four, and six inches long, and of the same breadth respectively, so as to double in the manner represented. Fig. 3, the part A is screwed, or clamped to a table of a convenient height, and a sheet of paper, one edge of which is put under the piece A, will be held fast to the table. The index P is to be set (at pleasure) with its sharp point to any part of an object which the eye sees through E the eye-piece.

"The machine is now to be doubled as in Fig. 3, taking care that the index is not disturbed; the point, which was before perpendicular, will then approach the paper horizontally and the place to which it points on the paper must be marked with a pencil. The machine must

be again unfolded, and another point of the object is to be ascertained in the same manner as before; the space between these points may be then connected with a line; fresh points should then be taken, marked with a pencil, and connected with a line; and so on successively till the whole object is delineated."

The above machine affords a delineation which is strictly accurate: but I take this opportunity of mentioning one still more portable, though less exact, which may be used in taking small sketches in the field; where the table, and fixed sheet of paper cannot always be supposed at hand. I do not know the contriver. It is merely a strait flat ruler, having a division of inches and small parts (or any other division) on its edge. A string is fastened to the middle of the ruler by passing it through a hole, and tying a knot on the other side; and at the other end of the string there is a small bead or knot to be held in the mouth. The length of the string may be adjusted at pleasure; and when the ruler is used, it is held up at right angles to the stretched string, so that its edge, as seen by one eye, may apply to any two objects; between which it will show the distance to be afterwards transferred upon the paper by a scale, or by estimate.

In this use of a graduated rule, it is most convenient and accurate to select some one object in the picture for the point of sight, and to measure all the distances from thence from the middle or beginning of the divisions where the direction of the sight is at right angles to the rule. And as this simple instrument does not give the inclinations, it may be best always to measure parallel or perpendicular to the horizon, and estimate the rest. Indeed, the contrivance must be considered only as a substitute for the usual method of estimating, and may be principally useful to assist in acquiring a correct judgment in this respect.

WILLIAM NICHOLSON.

No. 52.

A simple and accurate Method of Surveying on Shore, with such Instruments only as are in every one's Possession. By Captain John Mortlock.*

(With an engraving.)

SIR—Almost all our treatises on nautical surveying begin with the explanation and description of what are called the necessary instruments, which are described so numerous, and the price so considerable, that very few can procure them: Thus discouraged, they abandon every idea of making plans of such ports as they touch at, for want of what they conceive to be the necessary instruments.

To obviate this difficulty, and to render nautical surveying more general, I have, in the annexed paper, attempted to shew the mariner how to survey any port or place he may touch at, with great accuracy, little trouble, and without any expense for instruments. Should you find this simple method deserving of a place in your valuable Journal, I shall feel myself honoured by your inserting it. I am, &c.

J. Mortlock.

To Mr. Nicholson.

January 7, 1805.

FIRST make an eye-sketch of the place to be surveyed, as the annexed figure, numbering all the points, bays, rocks, shoals, &c. Choose two stations, as A and B, (fig. 4, plate 7,) whence all the rocks, points, &c. may be seen from, and so situated from each other, that the bearings of the points, &c. as taken from A and B, shall

* Nicholson, vol. 10, p, 103.

intersect at angles at least greater than ten degrees, but the nearer ninety degrees the better.

Having chosen the stations, proceed to one of them as A, and place the paper intended to receive the plan horizontally before you, extended by pins, or otherwise, on a board securely fixed, to prevent it shifting its position while the bearings are drawing.

Stick a pin through the paper firm into the board, at the part meant to represent the station A, and lay a ruler with a perfect straight edge on the paper, touching the pin at A and pointing towards the station B, and draw the line AB: in like manner draw lines from A towards all the points, rocks, bays, &c. numbering the lines as the points, rocks, bays, &c. are numbered in the eye-sketch: Proceed next to the station B, and place the board horizontally before you, so that the line AB shall point back towards A, and secure the board with the same precaution as at A, to prevent its shifting: then, in the line AB, stick a pin firm through the paper into the board, in that part meant to represent the station B; from which point draw lines pointing towards the different points, rocks, &c. as was done from A, numbering them in like manner. Now, where the lines drawn from B intersect those of the same number drawn from A, will be the place of the points, rocks, &c. to which the lines were directed to from the stations. Sketch in the shore between the points, &c. and the plan is completed.

The meridian-line may be found by compass, or more correctly, by drawing the line of the sun's bearing from one of the stations, and taking his altitude at the same time. Then with the latitude, altitude, and declination, compute the azimuth, and lay it off to the left or right of the line of the sun's bearing, according as the sun was to the right or left of the meridian, and it will give the true north and south, or meridian-line.

Scale for the Vanishing lines in Perspective.

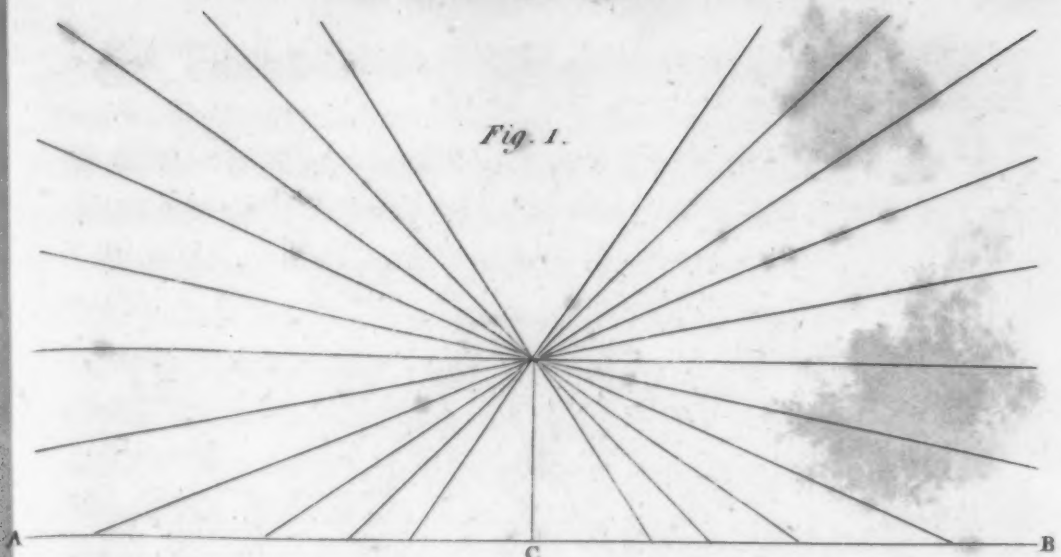


Fig. 1.

Instrument to fix the points in Perspective

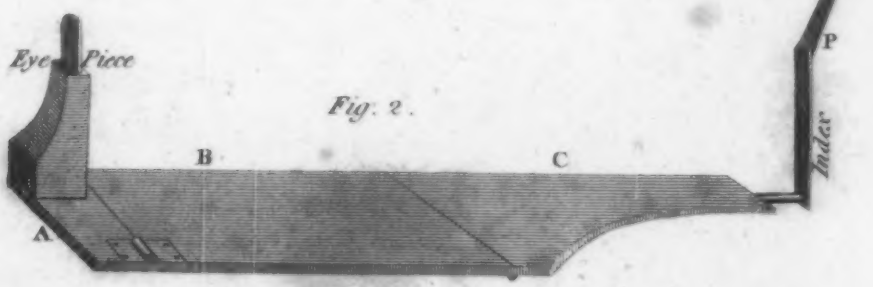
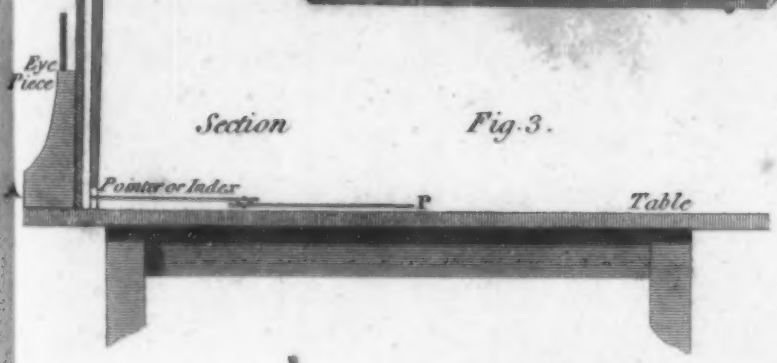


Fig. 2.



Section

Fig. 3.

Fig. 4.

Mortlocks surveying with very simple Instruments

Emporium of Arts & Sciences Vol. 2. pl. 7

If the distance between any two points on the shore be measured, it will give you a scale for the plan; but it may often be found more convenient to measure off a base, as AC, from one of the stations, in a direction nearly perpendicular to the line AB; and let it be in length equal to some part of a geographical mile, as 380 feet = $\frac{1}{10}$, or 760 = $\frac{1}{8}$, or 1520 = $\frac{1}{4}$ or 3040 = $\frac{1}{2}$, or any part of a mile; then will the line AC be a scale to the plan.

I have supposed any common board and ruler to illustrate the simplicity of this method of surveying: but to such as are provided with a drawing frame, it will be found convenient to extend the paper on; and if a ruler has sights perpendicular to its edge, it will be found commodious, and require less trouble. I hope the ease and expedition with which the whole is performed, will induce sea-faring people to amuse themselves by taking plans of the places they touch at: for it is by the improvement of geography that the dangers of navigation are diminished, and, consequently the lives and property embarked in our shipping are less exposed to danger.

No. 53.

Description of a simple Instrument for making correct Drawings from Nature. By T. C. B.*

(With an engraving.)

SIR—The description of two instruments for facilitating landscape drawing from nature given in the first volume, page 281, of your Journal,† has suggested to me the construction of another, which seems to unite the accuracy of the first of those instruments with the simplicity and portability of the second. As I conceive it may be

* Nicholson, vol. 10, p. 111.

† See p. 258 of this volume of the Emporium.

of some service to those who are in the habit of sketching landscape, I send you a description of one which I have had made, that you may, if you think proper, publish it in your Journal. Let AB, fig. 4, plate 8, be a flat rule, suppose twelve inches long, having at its extremities two arms BD and AF turning upon a joint at B and A; and in each arm a circular joint at C and G: let the length of each arm BD and AF be ten inches: a handle to fix on E, and a thread passing through two holes equidistant from the handle, making any length, according to the angle under which the view may be best seen.

To use the instrument, take the end of the thread in the mouth, and hold the instrument upright before the eye, then move either or both of the arms till the points D and F are brought in a line between the eye and any point in the landscape you may wish to delineate; lay the instrument upon the drawing paper, and you will have the true situation of such part of the subject.—Proceed in like manner, taking care always to keep the base line in the same place, till you get as many points as you require, by which means any landscape or building may be drawn very expeditiously, and with a great degree of accuracy.

To make the instrument as portable as possible, there is a joint in AB, which the handle covers, and the pieces DG and CF are made of thin brass, to fold into the pieces AC and BG; so that the instrument, when folded up, need occupy no more room in the pocket than a small spectacle case.

It is perhaps unnecessary to add that this instrument may be used for the purpose of copying, and answers the purpose of a triangular or quadrangular compass. I am, &c.

T. C. B.

To Mr. Nicholson.

January 22, 1805.

No. 54.

Description of the Camera Lucida. By WILLIAM H. WOLLASTON, *Secretary of the Royal Society.**

(With an engraving.)

HAVING a short time since amused myself with attempts to sketch various interesting views, without an adequate knowledge of the art of drawing, my mind was naturally employed in facilitating the means of transferring to paper the apparent relative positions of the objects before me; and I am in hopes that the instrument, which I contrived for this purpose, may be acceptable even to those who have attained to greater proficiency in the art, on account of the many advantages it possesses over the *Camera Obscura*.

The principles on which it is constructed will probably be most distinctly explained by tracing the successive steps, by which I proceeded in its formation.

While I look directly down at a sheet of paper on my table, if I hold between my eye and the paper a piece of plain glass, inclined from me downwards at an angle of forty-five degrees, I see by reflection the view that is before me, in the same direction that I see my paper through the glass. I might then take a sketch of it; but the position of the objects would be reversed.

To obtain a direct view, it is necessary to have two reflections. The transparent glass must for this purpose be inclined to the perpendicular line of sight only the half of forty-five degrees, that it may reflect the view a second time from a piece of looking glass placed beneath it, and inclined upwards at an equal angle. The objects now appear as if seen through the paper in the same place as before; but they are direct instead of being inverted, and

* Nicholson, vol. 17, p. 1.

they may be discerned in this manner sufficiently well for determining the principal positions.

The pencil, however, and any object, which it is to trace, cannot both be seen distinctly in the same state of the eye, on account of the difference of their distances, and the efforts of successive adaption of the eye to one or to the other, would become painful if frequently repeated. In order to remedy this inconvenience, the paper and pencil may be viewed through a convex lens of such a focus, as to require no more effort than is necessary for seeing the distant objects distinctly. These will then appear to correspond with the paper in *distance* as well as *direction*, and may be drawn with facility, and with any desired degree of precision.

This arrangement of glasses will probably be best understood from inspection of fig. 1, *a b* in the transparent glass; *b c* the lower reflector; *b d* a convex lens (of twelve inches focus) *e* the position of the eye; and *f g h e* the course of the rays. See plate 8.

In some cases a different construction will be preferable. Those eyes, which without assistance are adapted to seeing near objects alone, will not admit of the use of a convex glass; but will on the contrary require one that is concave to be placed in front, to render the distant objects distinct. The frame for a glass of this construction is represented at *i k*, (fig. 3,) turning upon the same hinge at *h* with a convex glass in the frame *l m*, and moving in such a manner, that either of the glasses may be turned alone into its place, as may be necessary to suit an eye that is long or short sighted. Those persons, however, whose sight is nearly perfect, may at pleasure use either of the glasses.

The instrument represented in that figure differs moreover in other respects from the foregoing, which I have chosen to describe first, because the action of the reflec-

tors there employed would be more generally understood. But those who are conversant with the science of optics will perceive the advantage that may be derived in this instance from prismatic reflection; for when a ray of light has entered a solid piece of glass, and falls from within upon any surface, at an inclination of only twenty-two or twenty-three degrees, as above supposed, the refractive power of the glass is such as to suffer none of that light to pass out, and the surface becomes in this case the most brilliant reflector that can be employed.

Fig. 2, represents the section of a solid prismatic piece of glass, within which both the reflections requisite are effected at the surfaces *a b*, *b c*, in such a manner that the ray *f g*, after being reflected first at *g*, and again at *h*, arrives at the eye in a direction *h e* at right angles to *f g*.

There is another circumstance in this construction necessary to be attended to, and which remains to be explained. Where the reflection was produced by a piece of plain glass, it is obvious that any objects behind the glass (if sufficiently illuminated) might be seen through the glass as well as the reflected image. But when the prismatic reflector is employed, since no light can be transmitted directly through it, the eye must be so placed that only a part of its pupil may be intercepted by the edge of the prism, as at *e*, fig. 2. The distant objects will then be seen by this portion of the eye, while the paper and pencil are seen past the edge of the prism by the remainder of the pupil.

In order to avoid inconvenience that might arise from unintentional motion of the eye, the relative quantities of light to be received from the object, and from the paper are regulated by a small hole in a piece of brass, which by moving on a centre at *c*, fig. 3, is capable of adjustment to every inequality of light that is likely to occur.

Since the size of the whole instrument, from being so near the eye, does not require to be large, I have on many accounts preferred the smallest size that could be executed with correctness, and have had it constructed on such a scale, that the lenses are only three quarters of an inch in diameter.

Though the original design, and principal use of this instrument is to facilitate the delineation of objects in true perspective, yet this is by no means the sole purpose to which it is adapted; for the same arrangement of reflectors may be employed with equal advantage for copying what has been already drawn, and may thus assist a learner in acquiring at least a correct outline of any subject.

For this purpose the drawing to be copied should be placed as nearly as may be at the same distance before the instrument that the paper is beneath the eye-hole, for in that case the size will be the same, and no lens will be necessary either to the object, or to the pencil.

By a proper use of the same instrument, every purpose of the pentagraph may also be answered, as a painting may be reduced in any proportion required, by placing it at a distance in due proportion greater than that of the paper from the instrument. In this case a lens becomes requisite for enabling the eye to see at two unequal distances with equal distinctness, and in order that one lens may suit for all these purposes, there is an advantage in carrying the height of the stand according to the proportion in which the reduction is to be effected.

The principles on which the height of the stem is adjusted will be readily understood by those who are accustomed to optical considerations. For as in taking a perspective view the rays from the paper are rendered

parallel, by placing a lens at the distance of its *principal* focus from the paper, because the rays received from the distant objects are *parallel;* so also when the object seen by reflection is at so short a distance that the rays received from it are in a certain degree *divergent,* the rays from the paper should be made to have the same degree of divergency in order that the paper may be seen distinctly by the same eye; and for this purpose the lens must be placed at a distance less than its principal focus. The stem of the instrument is accordingly marked at certain distances to which the conjugate foci are in the several proportions of 2, 3, 4, &c. to 1, so that distinct vision may be obtained in all cases, by placing the painting proportionally more distant.

By transposing the convex lens to the front of the instrument and reversing the proportional distances, the artist might also enlarge his smaller sketches with every desirable degree of correctness, and the naturalist might delineate minute objects in any degree magnified.

Since the primary intention of this instrument is already, in some measure, answered by the *Camera Obscura,* a comparison will naturally be made between them.

The objections to the Camera Obscura are

1st. That it is too large to be carried about with convenience.

The Camera Lucida is as small and portable as can be wished.

2dly. In the former, all objects that are not situated near the centre of view are more or less distorted.

In this, there is no distortion; so that every line, even the most remote from the centre of view, is as strait as those through the centre.

3dly. In that, the field of view does not extend beyond thirty degrees, or at most thirty-five degrees, with distinctness.

But in the *Camera Lucida* as much as seventy or eighty degrees might be included in one view.

No. 55.

Method of preparing Pannels for Painters. By Mr. S. Grandi.*

TAKE the bones of sheep's trotters, break them grossly, and boil them in water until cleared from their grease, then put them into a crucible, calcine them, and afterwards grind them to powder. Take some wheaten flour, put it in a pan over a slow fire until it is dry, then make it into a thin paste, add an equal quantity of the powdered bone-ash, and grind the whole mass well together: this mixture forms the ground for the pannel.

The pannel having been previously pumiced, some of the mixture above-mentioned is rubbed well thereon with a pumice-stone, to incorporate it with the pannel. Another coat of the composition is then applied with a brush upon the pannel, and suffered to dry, and the surface afterwards rubbed over with sand-paper.

A thin coat of the composition is then applied with a brush, and if a coloured ground is wanted, one or two coats of the colour is added, so as to complete the absorbent ground.

* Nicholson, vol. 16, p. 316.—The processes of Mr. Grandi being founded upon practice, were supported to the Society of Arts, by certificates from our most eminent painters; in consequence of which, and of the exhibition of the pannels, the Society awarded him the silver medal and twenty guineas.

Camera lucida

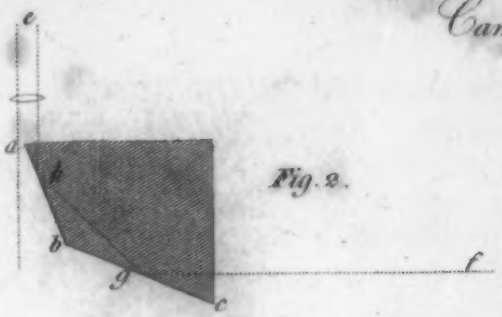


Fig. 2.

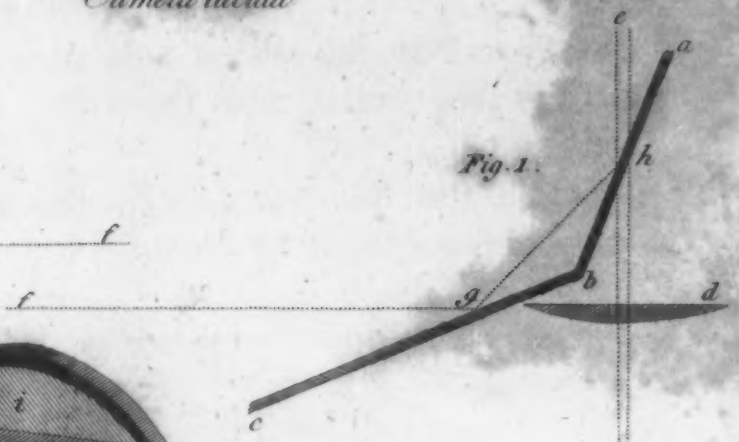


Fig. 1.

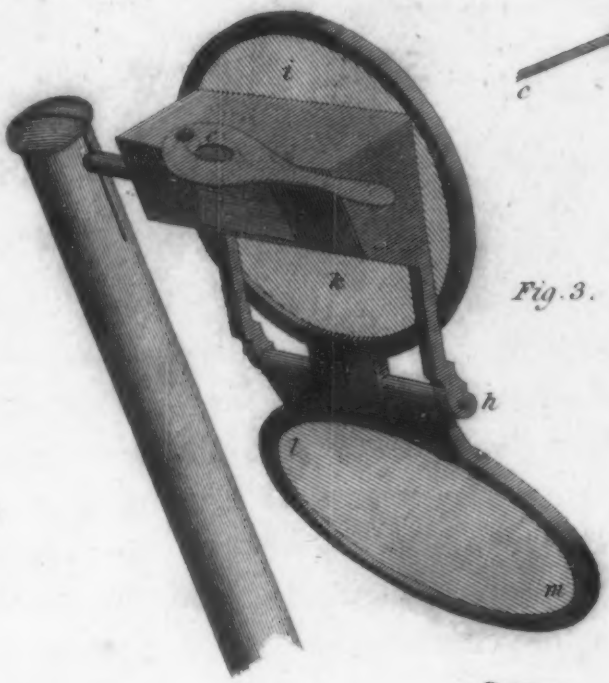


Fig. 3.

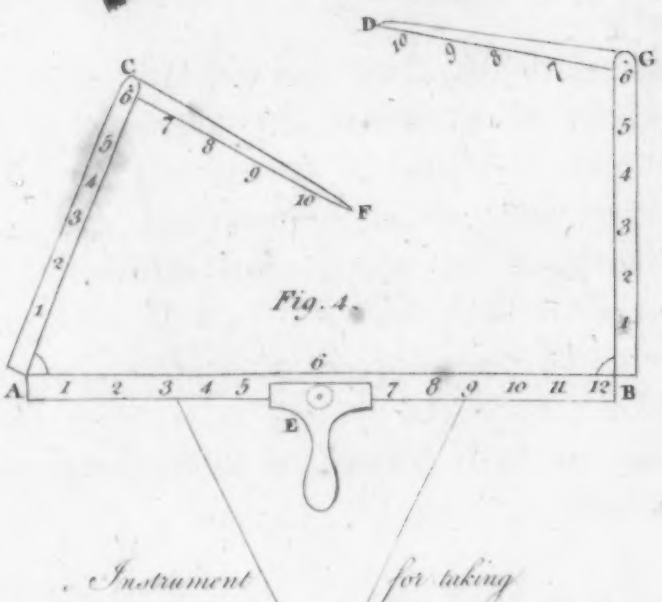


Fig. 4.

Instrument for taking designs from Nature

Emporium of Arts & Sciences Vol. 2. pl. 8. C. Tiebout.

When it is necessary to paint upon a pannel thus prepared, it must be rubbed over with a coat of raw linseed or poppy-oil, as drying oil would destroy the absorbent quality of the ground; and the painter's colours should be mixed up with the purified oil hereafter mentioned.

Canvass grounds are prepared, by giving them a thin coat of the composition, afterwards drying and pumicing them, then giving them a second coat, and, lastly, a coat of colouring matter along with the composition.

The grounds thus prepared do not crack; they may be painted on a very short time after being laid, and from their absorbent quality, allow the business to be proceeded upon with greater facility and better effect than with those prepared in the usual mode.

Method of purifying Oil for Painting.

Make some of the bone-ashes into a paste with a little water, so as to form a mass or ball; put this ball into the fire, and make it red hot; then immerse it for an hour, in a quantity of raw linseed oil, sufficient to cover it: when cold, pour the oil into bottles, add to it a little bone-ash, let it stand to settle, and in a day it will be clear and fit for use.

White Colour is made by calcining the bone of sheep's trotters in a clear open fire, till they become a perfect white, which will never change.

Brown Colour is made from bones in a similar manner, only calcining them in a crucible instead of an open fire.

Yellow Colour, or Masticot. Take a piece of soft brick, of a yellowish colour, and burn it in the fire; then take for every pound of brick, a quarter of a pound of flake white, grind them together and calcine them; after-

wards wash the mixture, to separate the sand, and let the finer part gradually dry for use.

Red Colour, equal to Indian-Red. Take some of the pyrites, usually found in coal-pits, calcine them, and they will produce a beautiful red.

Grey Colour is made by calcining together blue-slate and bone-ashes powdered, grinding them together, afterwards washing them, and drying the mixture gradually.

Blue-Black is made by burning vine-stalks in a close crucible in a slow fire, till a perfect charcoal is made of them, which must be well ground for use.

Crayons are made of bone-ash powder mixed with spermaceti, adding thereto the colouring matters. The proper proportion is, three ounces of spermaceti to one pound of the powder. The spermaceti to be first diffused in a pint of boiling water, then the white bone-ash added, and the whole to be well ground together, with as much of the colouring matter as may be necessary for the shade of colour wanted. They are then to be rolled up in the proper form, and gradually dried upon a board.

White Chalk, if required to work soft, is made by adding a quarter of a pound of whitening to one pound of the bone-ash powder will answer alone. The coloured chalks are made by grinding the colouring matter with bone-ashes.

NO. 56.

Account of the Method of Obtaining Patents. By Dr. WILLIAM THORNTON.

HAVING been requested by several persons to point out, in the Emporium, the mode to be pursued in obtaining a patent right from the United States, I have thought

it most advisable to publish at length the necessary proceedings, as detailed in a small pamphlet by Dr. Thornton, of the Patent Office, which contains every information on this subject.

EDITOR.

Patent Office, March 5, 1811.

HAVING the honour of directing or superintending the important duties of issuing patents for arts and inventions, which were formerly thought worthy of the labours of a council composed of the Secretary of State, the Secretary of War, and the Attorney General of the United States, I have thought it a duty to my fellow citizens to publish a few lines of information to facilitate the mode of acquiring patents, by which many will be enabled to dispense with long journies to the seat of government, or with troubling their friends with a tedious correspondence.

Viewing with astonishment the inventions of my countrymen, I cannot contemplate them without being impressed with the idea, that no nation on earth surpasses them in genius. Even the unlettered inhabitants of the forest have perfected inventions that would have done honour to Archimedes; and I reproach myself for not having published long ago a few directions how to proceed in securing the advantages of the efforts of their talents. This information would have been given, but I anxiously waited the proposed revision of the patent law, which has been under the consideration of the honourable the congress for seven years; and, if I delay this short sketch any longer, I fear it may be said,—

> He who defers his work from day to day,
> Does on a river's bank expecting stay
> 'Till the whole stream, which stops him, should be gone;
> But, as it runs, forever 'twill run on.

Before an application be made for a patent, I would advise the inventor to examine well the Dictionaries of the Arts and Sciences, the Repertory of the Arts, and other publications that treat of the mechanic arts, to endeavour to ascertain if the invention be new; also to make inquiry of scientific characters, whether or not the invention or discovery be practicable. These previous inquiries will sometimes prevent great trouble, and save the expense of much time, labour, and money; for a patent does not confer rights where just claims do not exist; and, as there is at present no discretionary power to refuse a patent, even where no just claim exists, it may be proper to caution the purchaser of patent rights against the supposition, that the invention patented is always valuable, or new, or that it interferes with no previous patent. The respectable names of the President, the Secretary of State, and the Attorney General, are requisite to give validity to a patent; but ought never to be considered, in any degree, as an evidence of the originality or utility of the invention. The issuing of patents is grounded not only on a desire to promote the progress of useful arts, but also to prevent the loss of valuable secrets; for many have been buried with the inventors, previous to the organization of this system of protection for the property of talent, mind, and genius. Formerly the arcana of any profession were withheld from the Tyro; his initiation was gradual and secret; and the caution with which inventors worked, to prevent the infringement of unprotected rights, confined many important inventions to limits too narrow to materially benefit either the inventors or the world; at present the law grants a monopoly to the inventor, for a limited time, provided the art, invention, discovery, or machine be duly explained, deposited, and recorded, for the benefit of mankind, as soon as the time limited has expired; and the patent is not

only an evidence that the inventor has formally confided his secret to the public, but also a declaration of the protection of the right from infringement; nevertheless of the infringement of the right, by others, a jury of the country is only competent to decide.

The general law, concerning the issuing of patents, will be found in the second volume of the Laws of the United States, page 200. This law provides for citizens only; but a subsequent law (vol. 5, page 88) provides also for applicants who have resided two years, or upwards, in the United States, and who are not citizens.

In applying for a patent it is necessary to attend to every legal form; for, in consequence of inattention to forms only, some of the patents issued formerly, have, in the courts of law, been declared to be null and void.*

Mode of Application.

"Every inventor, before he presents his petition to the Secretary of State, signifying his desire of obtaining a patent, shall pay into the treasury of the United States thirty dollars,† for which he will be furnished with duplicate receipts, one of which he shall deliver to the Secretary of State when he presents his petition; and the money, thus paid, shall be in full for the sundry services to be performed in the office of the Secretary of State, consequent to such petition."‡ This petition must be addressed to the Secretary of State, and may be in the following, or in a similar style:

* Oliver Evans's, among the number.

† Notes of any of the banks of the United States

‡ See Laws of the United States, vol. 2, chap. xi, § 11, p. 205.

TO THE HONOURABLE JAMES MONROE, SECRETARY OF STATE OF THE UNITED STATES:

The petition of A. B. of ——— in the county of ——— and state of ——— respectfully represents:

THAT your petitioner has invented a new and useful improvement ["or art, machine, manufacture, or composition of matter, or any new and useful improvement in any art, machine, manufacture, or composition of matter] in ——— not known or used before his application," the advantages of which he is desirous of securing to himself and his legal representatives: he therefore prays that letters patent of the United States may be issued, granting unto your petitioner, his heirs, administrators, or assigns, the full and exclusive right of making, constructing, using, and vending to others to be used, his said improvement, [art, invention, machine, manufacture, or composition of matter, &c.] agreeably to the acts of Congress in such case made and provided; your petitioner having paid thirty dollars into the treasury of the United States, and complied with the other provisions of the said acts.

A. B.

The *specification* or description of the machine, art, discovery, or invention, must be given in clear and specific terms, designating it from all other inventions, and describing the whole in such a manner as to comprehend not only the form and construction, if a machine, but also the mode of using the same; and if it be only an improvement on a certain machine already invented by the applicant or any other, it ought to be so mentioned or described; and as this specification, description, or schedule, enters into and forms part of the patent, it must be without any references to a model or drawing, and must

be signed by the applicant, or applicants, before two witnesses. It is material that this be in good language, and correctly written, as it is transcribed into the patent, and the original papers will be deposited in an office that will hand them down to posterity, by which the honour of the country is concerned in this attention. The modest inventor will no doubt exclude those panegyrics on the excellence of his invention or discovery, which abound sometimes in the productions of the inferior genius, but which ought not to enter into the patent.

The following, or a similar oath or affirmation, taken [before a judge of any of the courts, or a justice of the peace, or any person qualified to administer an oath] by the applicant, or applicants, must be subjoined to the specification, if citizens of the United States.

Form.

County of ——— } *ss.*
State of ——— }

On this — of ——, 18—, before the subscriber, a justice of the peace, in and for the county aforesaid, personally appeared the above named A B, and made solemn oath [or affirmation] according to law, that he verily believes himself to be the true and original inventor or discoverer of the art [machine, invention, or improvement, composition of matter, &c.] above specified and described, for ——— (mention here the object or intention) —— and that he is a citizen of the United States.

———, J. P.

If not a citizen (or citizens) the following addition must be made to the declaration, that he verily believes himself to be the true and original inventor or discoverer of the art, &c.

"*And that the same hath not, to the best of his or her knowledge or belief, been known or used either in this or*

any foreign country.——————————————"*
Also, that he (or she) hath resided in the United States two years and upwards.————

————J. P.

The specification must be accompanied by a good drawing, in perspective, of the whole machine or apparatus, "where the nature of the case admits of drawings; or with specimens of the ingredients, and of the composition of matter, sufficient in quantity for the purpose of experiment, where the invention is of a composition of matter. And such inventor shall, moreover, deliver a model of his machine, provided the Secretary shall deem such model to be necessary."† It is requisite, in giving a drawing of the machine, to give also sectional drawings of the interior, when the machine is complex: and every drawing should be accompanied with explanatory references. When a machine is complex, a model will likewise be necessary, not only to explain and render it comprehensible to a common capacity, but also to prevent infringements of rights; for many will plead ignorance of drawings, who cannot avoid the conviction of wheels and pinions.

The drawings ought not to exceed a quarto size, and if confined to octavo they would be still better, where it can be done conveniently and distinctly.

Many of the drawings in this office are executed in a very handsome style, and do much credit to the talents of the gentlemen whose names are ascertained. If the artists would always sign them, information might be given to the applicants for patents where to apply for drawings.

* Laws of the United States, vol. 5, chap. xxv, p. 89.

† Ibid, vol. 2, chap. xi, p. 202.

Among the best I have received, I notice the names of Messrs. James Aiken, Philadelphia; John Bernard, Utica, Oneida County, New York; Jacob Cist, P. M. Wilkesbarre, Pennsylvania; Francis Guy, Baltimore; George Hadfield, Washington city; Philip Hooker, Albany, New York; Nicholas King, Washington city; —— Peckham, Roxbury, Massachusetts; John R. Penniman, Boston; Abner Reed, Connecticut; Archibald Robertson, No. 78, Liberty street, New York; John F. Somerby, Catskill, New York; —— Steward, Hartford, Connecticut; John Stickney, Baltimore; —— Stiles, Worcester, Massachusetts; William Stickfand, Philadelphia; James Watson and John Watts, Utica, Oneida County, New York.

Many being without the names of the artists, I cannot do all the justice I wish.

The papers must all be sent under cover to the Secretary of State, which of course renders them free of postage: but if models be sent, their freight or carriage hither must be paid; and before packing them the name or names of the inventor or inventors should be written thereon, with the name of the machine and the date; for sometimes on receiving them it is difficult to know to whom they appertain.

The congress, being impressed with a high sense of the value of the inventions of our citizens, have purchased an elegant and extensive building, wherein preparations are now making for the accommodation of a very numerous collection of the machines, illustrative of the ingenuity displayed; and this museum of the arts, it is presumed, will stimulate the ingenious to send the models of their machines and inventions in a style that will rather honour than discredit our country.

Copy-rights of books, prints, charts, maps, &c. are secured "by depositing, before publication, a printed copy

of the title of such map, chart, book or books, in the clerk's office of the district court, where the author or proprietor shall reside, who will record the same; and the author or proprietor shall, within two months from the date of the record, cause a copy of the said record to be published in one or more of the newspapers printed in the United States, for the space of four weeks.* And within six months after publishing the map, chart, book or books, the author or proprietor shall deliver, or cause to be delivered to the Secretary of State, a copy of the same; and when deposited and entered in the patent office, a certificate will be returned of its being received."† This will secure the sole right of publication for fourteen years to the author or proprietor, if a citizen of the United States, or resident therein.‡ "And if at the expiration of the said term, the author or authors, or proprietors, or any of them, be living, and a citizen or citizens of these United States, or residents therein, the same exclusive right shall be continued to him or them, his or their executors, administrators, or assigns, for the further term of fourteen years: *Provided* he or they shall cause the title thereof to be a second time recorded, and published in the above manner, within six months before the expiration of the first term of fourteen years aforesaid."

WILLIAM THORNTON.

In order to complete this account of the method of obtaining a patent, the Editor has given, in the next page, a copy of the letters patent.

* See an act for the encouragement of learning, &c.—Laws of the United Statss, vol. 1, chap. 15, § 3, p. 121.

† Ibid, Sec. 4, p. 122.

‡ Ibid, Sec. 1, p. 118, 119.

No. 57.

Description of an Improvement in the Common Bedstead, by JOHN REDMAN COXE, *with a Copy of the Letters Patent, granted for the same.*

(With an engraving.)

THE United States of America, to all to whom these letters patent shall come:

Whereas John Redman Coxe, a citizen of the United States, hath alleged that he has invented a new and useful improvement in the construction of bedsteads, which improvement he states has not been known or used before his application; has made oath that he does verily believe that he is the true inventor or discoverer of the said improvement, has paid into the treasury of the United States, the sum of thirty dollars, delivered a receipt for the same, and presented a petition to the Secretary of State, signifying a desire of obtaining an exclusive property in the said improvement, and praying that a patent may be granted for that purpose: These are therefore to grant, according to law, to the said John Redman Coxe, his heirs, administrators, or assigns, for the term of fourteen years, from the sixteenth day of October, 1812, the full and exclusive right and liberty of making, constructing, using and vending to others to be used, the said improvement; a description whereof is given in the words of the said John Redman Coxe himself, in the schedule hereto annexed, and is made a part of these presents.

In testimony whereof I have caused these letters to be made patent, and the seal of the United States to be hereunto affixed.

Given under my hand, at the city of Washington, this sixteenth day of October, in the year of our Lord, one thousand eight hundred and twelve; and of the indepen-

dence of the United States of America, the thirty seventh.

JAMES MADISON.

******
SEAL.
******

By the President.

JAMES MONROE,
Secretary of State.

City of Washington, to wit:

I DO hereby certify, that the foregoing letters patent, were delivered to me on the sixteenth day of October, in the year of our Lord, one thousand eight hundred and twelve, to be examined; that I have examined the same, and find them conformable to law: and I do hereby return the same to the Secretary of State, within fifteen days from the date aforesaid, to wit: On this sixteenth day of October, in the year aforesaid.

WILLIAM PINKNEY,
Attorney General of the United States.

THE SCHEDULE referred to in these *letters patent,* and making part of the same, containing a description in the words of the said John Redman Coxe himself, of his improvement in the construction of bedsteads.

A SOURCE of trouble, not unfrequent in domestic life, is derived from the present construction of our bedsteads: the necessity of occasionally separating and replacing their parts, by the inattention or ignorance of the persons employed, soon proves destructive to the firmness and solidity of the joints, and gives an harbour to the most disagreeable of companions, the common bed bug.

Before I describe the improvements in the bedstead, which I think I have made, I shall concisely state some of the inconveniences and imperfections of the present construction.

These are,—

1st, The employment of screws, which pass through the posts, and deep into the rail, to penetrate the nut; together with the interior mortice in the post for the reception of the tenon cut on the rail. The screws are generally badly made of defective iron; and the heads are so soft, as to be speedily worn down by the action of the screw driver; and, by the misplacement of the screw, the nut is often loosened, and rendered of little importance to the firmness of the parts connected.

2nd, From the above sources, as well as from the usual roughness in the finish of the holes, the mortices, and the tenons; the bed bug, as above mentioned, readily makes a lodgment; which leads, of consequence, to the frequent use of hot water, lye, corrosive sublimate, and other domestic applications, too often, alas, incompetent to their complete destruction!

3rd, By such frequent ablutions, the parts are injured by swelling, the nuts are rusted, and the bedstead is often more closely kept together by the tightness of the sacking, than by the screws, &c. intended for this purpose.

4th, The head-board is now fixed firmly in the posts, and for its removal the complete separation of the bedstead becomes necessary. The difficulty of this, and of replacing the parts accurately, except to a professed joiner, will be admitted; especially as it is generally left to a careless and inexperienced domestic, to the almost necessary destruction of the bedstead in a short time.

By the plan I am about to describe, many, if not all, of the above difficulties are obviated, since the most stupid and inexperienced can scarcely fail of taking a bedstead apart and replacing it, as accurately as the best workman.

The post and rails are here completely solid,—no holes, no screws or nuts, no tenons or mortices, are

found in the bedstead. The rails come flush against the posts, and the tenon and mortice are supplied by a small bolt beneath the rail, which shoots into the post about half an inch. The smoothness of the surfaces is a powerful obstacle to a secure lodgment of the bed bug or its eggs, and this part may be even still further secured, if necessary, by a coat of paint. The bolt is sunk into the wood to its level, and a brass cap may be sunk into the post for the bolt to shoot in, with even more accuracy than into the wood.

To the outside of the rail, (which is usually about four inches wide,) where it meets the post, is firmly screwed a brass hinge three inches in breadth, and sunk into the wood to its level, leaving half an inch of the rail visible above and below. The joint of this hinge, not being exactly central, falls within the edge of the rail, whilst the other portion crosses its junction with the post, into which it is accurately sunk likewise to its level. This moveable part of the hinge has two oblong openings or eyes, near its extremity, to receive two corresponding catches from a plate beneath; and behind these catches a wedge-like key falls down, and firmly fastens the post and rail. The edge of the hinge on this side is raised nearly to a level with the projecting catches, in form of a wedge or inclined plane, interiorly, the broadest part below, so as to prevent the key from slipping out sideways; and serving to increase the power of the key, since they resemble two wedges acting against each other.

The plate, to which these catches are attached, is sunk into the post below the lower level of the hinge, and is there firmly screwed on a level with the wood beneath. The whole of this plate, with the catches, will probably be better constructed of steel than of brass, since an equal strength will thereby be obtained, with a far inferior thickness.

It is evident, that the common low-post bedstead may be connected by the present plan; or the head and foot rail may still be joined permanently to the posts, leaving the side rails to be attached by the hinge and bolt.

The head board is fixed, in my plan, to the posts either by a small moulding attached to them firmly, with a flat posterior surface, against which the front edge of the board rests, and which prevents its escaping forwards; whilst behind, the board is provided on each side, above and below, with a small bolt sunk into it on a level, and which shoots into a corresponding hole in the post. Or a small catch, formed like the one half of the catch and plate described above, is fixed into the head board, in the places of the bolts, and fall down into a notch cut into a small piece of brass, which is permanently fastened into the posts. In either case, it is clear, that it may be immediately removed from the bedstead, and that its attachment is perfectly adequate to every intention of this part.

It is equally evident from this description, that nothing more is required to take down this bedstead than merely to draw back the bolts beneath the rails, to pull out the key from the hinges and to turn them back, when the whole is at once separated; the affixing the parts together is equally simple.

By this improvement, I claim every mode of junction in a bedstead formed upon the principle of any union of catches, bolts, or hinges, or of either separately:—of any connection by a common hook and eye, connected with bolts, &c. or by the dining-table staple-fastenings, &c. of which last my first attempt consisted, and which I find to answer perfectly well.

JOHN REDMAN COXE.

Witnesses. { LEWIS WALKER, ANDREW PETTIT.

Reference to the Engraving. Plate 9.

Fig. 1. A bedstead in perspective, exhibiting the general connection of the parts by hinges and bolts.

a a a a, the bolts beneath the rails, shooting into the posts.

Fig. 2. The hinge separate from the bedstead. *a*, the part which is firmly screwed into the rail. *b*, the dotted line, shows the relative situation of the joining of the post and rail, which is not immediately beneath the joint of the hinge. *cc*, the two oblong holes of the hinge, through which the catches pass, that retain the key, or wedge, in its place. *d*, the edge of the hinge, on a level with the elevation of the key, and which, by its angular form, increases its wedge-like action.

Fig. 3. The plate which is permanently let in and screwed to the post beneath the hinge. *e, e*, the projecting catches of the plate, which pass through the oblong openings of the hinge *cc*, fig. 2, and behind which catches, the key falls down anterior to the hinge.

Fig. 4. The wedgelike key that falls behind the catches. This may be attached by a small chain to the post.

Fig. 5. The hinge, when keyed.

Fig. 6. A small piece of brass, with a notch, screwed into the post; into which notch, a catch on the headboard, similar to one of those above mentioned, *e*, fig. 3, falls, and thus attaches it firmly: Four of these are necessary; or four small bolts, fixed in the headboard, may be employed in their place, to shoot into the posts.

N. B. The plates may be screwed to the bedstead by screws of a proper size, and having their heads made *blue* by the action of heat. This gives an additional or-

Coxe's improved patent bedstead.

Fig. 1.

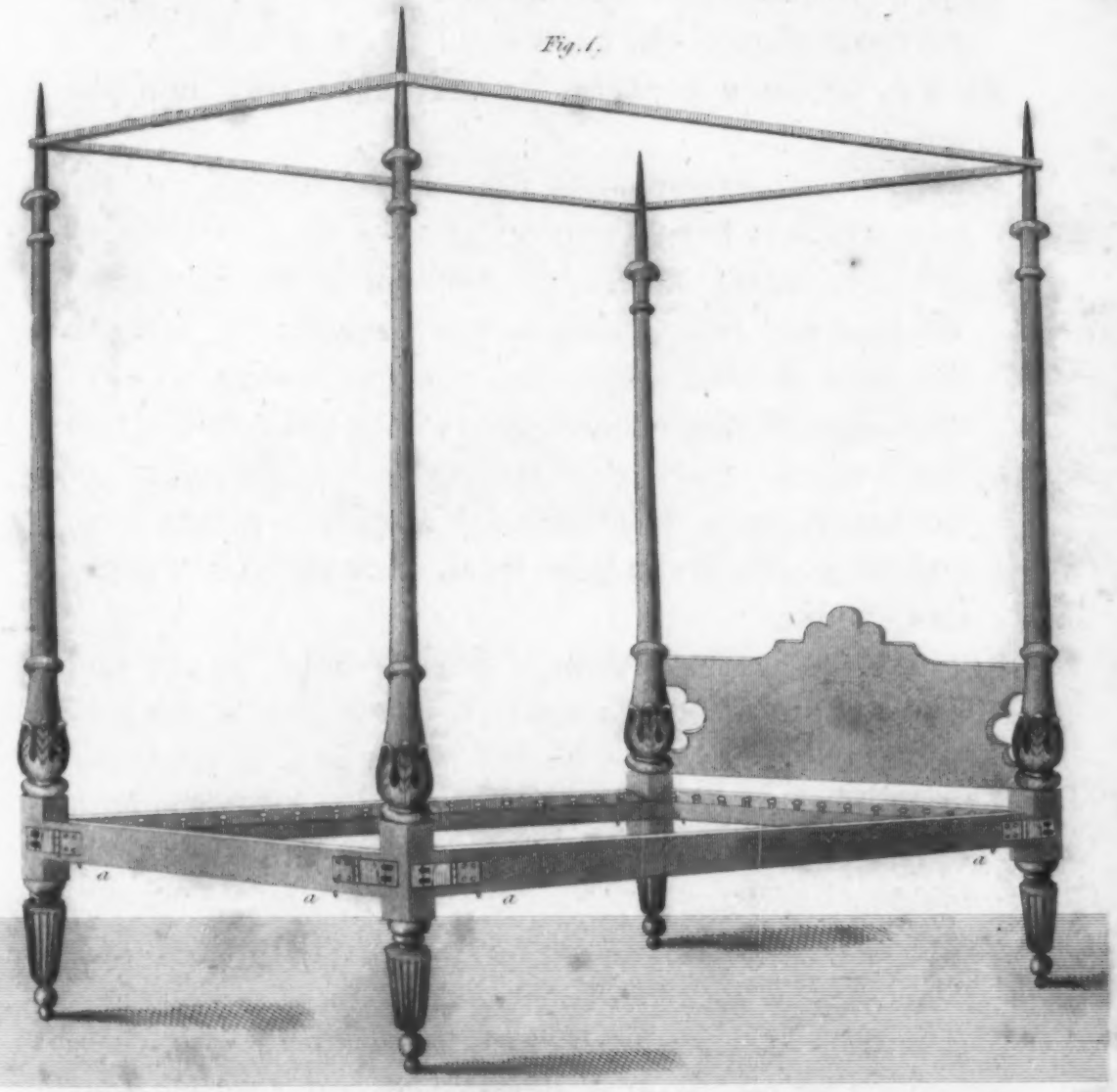


Fig. 2.

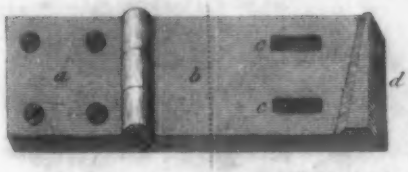


Fig. 4.

Fig. 5.

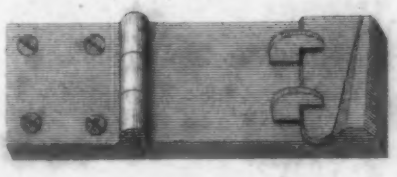


Fig. 3.

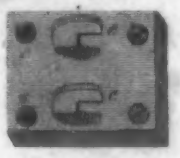


Fig. 6.

Emporium of Arts & Sciences Vol. 2 Pl. 9

D^r Coxe inv.^t W. Strickland del.^t

C. Tiebout & A.L. Anson sculp.^t

nament to the brass plates. The plates themselves may be likewise rendered highly ornamental by fret work, or by bronzed figures, as lions' heads, &c. attached to them. It is proposed to apply a similar contrivance to connect the sides and bottoms of sophas, which will add to their beauty, and render them capable of being taken apart, as a bedstead. A bedstead on the above plan may be seen at Mr. Thomas's, cabinet maker, in fifth street, below Walnut.

NO. 58.

An Experiment on Soap-Suds as a Manure. By Mr. GEORGE IRWIN; *with Remarks by the Reverend* THOMAS FALCONER.*

A FEW years ago my attention was attracted by the soil of a garden, reduced to a state of poverty very unfriendly to vegetation. Interest in its future produce influenced my wishes for its restoration. An invigorating manure was necessary; but such a stimulus could not be easily procured. While considering which of the succedanea within my reach had the greatest probable appearance of succeeding, it occurred, that possibly some trivial advantage might be derived from the oil and alkali suspended in the waters of a washing.† Pits were immediately ordered to be made, and in them the contents of a tub, which my servant usually committed to the common sewer, were carefully deposited: as washing succeeded

* Nicholson, vol. 20, p. 99. From *Papers of the Bath and West of England Society*, vol. 11, p. 261.

† It is the common practice of some parts, at least, of the west of England, to use a lixivium, made by passing water through an appropriate strainer containing wood ashes, for the purpose of washing. This was probably the case here, though not mentioned by the author.

washing, other pits were dug and filled; so that the whole garden, a small portion only excepted, has in this manner been watered and enriched: that small portion remains a visible demonstration of the utility of this manure. There vegetation is still languid; while the residue of the garden, invigorated by the suds only, annually exhibits a luxuriance almost equal to any thing this fertile neighbourhood can produce. I am, &c.

GEORGE IRWIN.

Remarks by the Reverend THOMAS FALCONER.

1. The above important experiment may perhaps remind the reader of the principal ingredients of the oil compost, suggested by Dr. Hunter of York. In the simple fluid manure we have an animal oil, potash, and water; in the compost are the same oil and the same alkali, but neither of them, perhaps, in so pure a state as in the manure, with the addition of "fresh horse-dung." The fresh horse-dung is added, in order to produce "heat and fermentation; and a delay of "six months" is supposed to be necessary, to make the compost "fit for use." All, however, that seems to be gained by the horse-dung, is the animal oil, which may be united to the alkali during the process of fermentation, and the straw, which in the fermentation of the compost will bind the mass together, and when decomposed on the ground will afford a small supply of vegetable matter. If we make the comparison strictly accurate on the other side, we may observe, that in the fluid manure there must be an increased quantity of animal matter in the water, after it has been used for the purpose of washing linen.

The experiment then shows what is the advantage of the application of the oil and alkali only, as a manure, and perhaps the delay of "six months" in preparing the

compost would not be compensated by any superior efficacy, that may be expected to arise from the combination of the horse-dung.

It also appears from the experiment, that the compost is a more useful discovery than Dr. Hunter himself could justly infer from his own limited experience of its effects.

2. This mixture of an oil and an alkali has been more generally known than adopted, as a remedy against the insects which infest wall-fruit trees. It will dislodge and destroy the insects, which have already formed their nests and bred among the leaves. When used in the early part of the year, it seems to prevent the insects from settling upon them; but whether by rendering the surface of the leaf disagreeable to the bodies of the animals, and thus repelling them, or by neutralizing the acid they deposit, and thus preventing the leaf from contracting into a necessary form for their reception, I cannot presume to determine. One of the modes, by which this mixture indirectly contributes to the fertility of the ground, may be by its destruction of the insects, which prey upon the plants.

It is also, I think, to be preferred to the lime water, or the wood ashes and lime, which Mr. Forsyth recommends to be used for the removal of insects. It is preferable to the lime water and the lime, because lime loses its causticity, and with that its efficacy, by exposure to air, and must consequently be frequently applied; and to the dredging the leaves with the fine dust of wood ashes and lime, because the same effect is produced by the mixture without the same labour, and is obtained without expense.

Mr. Speechley, in his treatise on the Vine, published in 1796, has used this mixture with great success; but he has applied it awkwardly and wastefully. He directs it

to be poured from a ladder out of "a watering pot over both trees and wall, beginning at the top of the wall, and bringing it on in courses from top to bottom:" page 161. Mr. Speechley is not the first person who has thought of this application of the mixture. It is a fact which has been long known and neglected.

A considerable extent of wall may be washed by means of a common garden pump in a short time; and this operation should be repeated as often as a supply of the mixture can be procured; or if the water of a washing cannot be had, a quantity of potash of commerce dissolved in water may be substituted.* The washing of the trees and wall twice a week for three or four weeks in the spring will be sufficient to secure them from the injuries of these insects.

On the whole, then, this must be considered as a valuable manure, as it can be obtained easily, at small expense, and in large quantities; and, when its nature is well understood, will probably be no less esteemed by the farmer than horse dung. To the gardener, as well as to the farmer, it is useful, mixed with mould, as a fertilizing compost; or, when fluid may be applied to his fruit-walls, as a wash fatal to the noxious brood of predatory insects.

THOMAS FALCONER.

NO. 59.

On the Revival of an Obsolete Mode of managing Strawberries. By the Right Honourable Sir JOSEPH BANKS, *Bart. K. B. P. R. S. &c.*†

THE custom of laying straw under strawberry plants, when their fruit begins to smell, is probably very old in

* Mr. Speechley uses his mixture warm, to soak the shreds, and wash the wall, more effectually.

† Nicholson, vol. 19, p. 95. From the *Transactions of the Horticultural Society*, vol. 1, part i, p. 54.

this country: the name of the fruit bears testimony in favour of this conjecture; for the plant has no relation to straw in any other way, and no other European language applies the idea of straw in any shape to the name of the berry, or to the plant that bears it.

When sir Joseph Banks came to Spring Grove, in 1779, he found this practice in the garden: John Smith, the gardener, well known among his brethern as a man of more than ordinary abilities in the profession, had used it there many years; he learned it soon after he came to London from Scotland; probably at the Neat Houses, where he first worked among the market gardeners, it is therefore clearly an old practice, though now almost obsolete.

Its use in preserving a crop is very extensive: it shades the roots from the sun; prevents the waste of moisture by evaporation, and, consequently, in dry times, when watering is necessary, makes a less quantity of water suffice than would be used if the sun could act immediately on the surface of the mould; besides, it keeps the leaning fruit from resting on the earth, and gives the whole an air of neatness as well as an effect of real cleanliness, which should never be wanting in a gentleman's garden.

The strawberry beds in that garden at Spring Grove, which has been measured for the purpose of ascertaining the expense incurred by this method of management, are about seventy-five feet long, and five feet wide, each containing three rows of plants, and of course requiring four rows of straw to be laid under them. The whole consists of six hundred feet of beds, or eighteen hundred feet of strawberry plants, of different sorts, in rows. The strawing of these beds consumed this year, 1806, the long straw of twenty-six trusses, for the short straw being as good for litter as the long straw, but less applicable to

this use, is taken out; if we allow then, on the original twenty-six trusses, six for the short straw taken out and applied to other uses, twenty trusses will remain, which cost this year ten pence a truss, or sixteen shillings and eight pence, being one penny for every nine feet of strawberries in rows.

From this original expenditure the value of the manure made by the straw when taken from the beds must be deducted, as the whole of it goes undiminished to the dunghill as soon as the crop is over. The cost of this practice, therefore, cannot be considered as heavy; in the present year not a single shower fell at Spring Grove, from the time the straw was laid down till the crop of scarlets was nearly finished at the end of June. The expense of strawing was therefore many times repaid by the saving made in the labour of watering, and the profit of this saving was immediately brought to account in increase of other crops, by the use of water spared from the strawberries; and besides, the berries themselves were, under this management, as fair and nearly as large as in ordinary years, but the general complaint of the gardeners this year was, that the scarlets did not reach half their natural size, and of course required twice as many to fill a pottle as would do it in a good year.

In wet years the straw is of less importance in this point of view, but in years moderately wet, the use of strawing sometimes makes watering wholly unnecessary, when gardeners who do not straw are under the necessity of resorting to it; and we all know if watering is once begun, it cannot be left off till rain enough has fallen to give the ground a thorough soaking.

Even in wet years the straw does considerable service, heavy rains never fail to dash up abundance of mould, and fix it upon the berries, this is entirely prevented, as well as the dirtiness of those berries that lean down upon

the earth, so that the whole crop is kept pure and clean: no earthy taste will be observed in eating the fruit that has been strawed, and the cream which is sometimes soiled when mixed with strawberries, by the dirt that adheres to them, especially in the early part of the season, will retain to the last drop that unsullied red and white, which give almost as much satisfaction to the eye while we are eating it, as the taste of that most excellent mixture does to the palate.

No. 60.

On the Advantages of Grafting Walnut, Mulberry, and Chesnut Trees. By Thomas Andrew Knight, *Esquire, F. R. S. &c.**

IN the course of very extensive experience in the propagation of apple and pear trees, I found that the detached parts of the bearing branches of old trees of those species, when employed as grafts, never formed what could with propriety be called young trees: the stocks appeared to afford nutriment only; and the new plants retained, in all instances, the character and habits of the bearing branches of which they once formed parts; and generally produced fruit the second or third year after the grafts had been inserted.†

I was therefore induced to hope, that the effects of time might be anticipated in the culture of several fruits, the

* Nicholson, vol. 19, p. 175. From the *Transactions of the Horticultural Society*, vol. 1, p. 60.

† Columella appears to have known, that a cutting of a bearing branch did not form a young tree; for speaking of cuttings of the vine (semina) he says, "optima habentur a lumbis; secunda ab humeris; tertia summa in vite lecta, quæ celerrime comprehendunt, et sunt feraciora, sed et quam celerrime senescunt." *De Arboribus*, chap. 3.

trees of which remain unproductive during many years after they are planted: and that parts of the bearing branches of those, detached from the old trees, and employed as grafts, would still retain the character and habits of bearing branches.

Having therefore planted in the spring of 1799 some walnut trees, of two years old, in garden pots, I raised them up to the bearing branches of an old walnut tree, by placing them on the top of poles placed in the earth; and I grafted them, by approach, with parts of the bearing branches of the old tree. A union took place during the summer, and in the autumn the grafts were detached from the parent stock. The plants thus obtained were planted in a nursery, and without any peculiar care or management, produced both male and female blossoms in the third succeeding spring, and have since afforded blossoms every season. The frost has, however, rendered their blossoms, as well as those of other trees in their vicinity, wholly unproductive during the last three years, and in the spring of 1805, almost wholly destroyed the wood of the preceding year. A similar experiment was made in the same year, but under many disadvantages, on the mulberry tree. I had not any young plants of this tree, and therefore could only make the experiment with scions of one year old; and of these I had only two, which had sprung from the roots of a young tree, in the preceding year. These were planted in pots, and raised to the bearing branches of an old tree, in the manner I have already described in speaking of the walnut tree. One of these scions died; the other, which had but very few roots, succeeded; and the young grafted tree bore fruit the third year, and has continued annually productive. In the last spring I introduced it into my vinery, where its fruit ripened in the greatest state of perfec-

tion, in the beginning of the present month, [January, 1807].

Both the walnut and mulberry tree succeed so ill when grafted, unless by approach, that I can scarcely recommend attempts to propagate them in any other way: but when they succeed by other modes of grafting, nearly the same advantages will probably be obtained: the habit of the bearing branch is, however, least disturbed by grafting by approach.

The Spanish chesnut succeeds readily when grafted in almost any of the usual ways, and when the grafts are taken from bearing branches, the young trees afford blossoms in the succeeding year: and I am much inclined to think, from experiments I have made on this tree, that by selecting those varieties which ripen their fruit early in the autumn, and by propagating with grafts or buds from young and vigorous trees of that kind, which have just attained the age necessary to enable them to bear fruit, it might be cultivated with much advantage in this country, both for its fruit and timber.

I have tried similar experiments on many other species of trees, and always with the same result; and I entertain no doubt, that the effects of time might be thus anticipated in the culture of any fruit, which is not produced till the seedling trees acquire a considerable age. For I am thoroughly confident, from very extensive and long experience, that the graft derives nutriment only, and not growth, from the young stock in which it is inserted; and that with the life of the parent stock the graft retains its habits and its constitution.

No. 61.

An Inquiry into the Causes of the Decay of Wood, and the Means of preventing it. By CHARLES H. PARRY, *M. D.**

THE power of wood in different forms to supply luxury, to promote science, and to guard and prolong human life, has made the means of preserving it from decay highly interesting to mankind. With this view various premiums have been offered by this and other economical societies. The object of the following discussion is to suggest the best means of prevention, chiefly by inquiring into the nature and sources of the evil against which it is intended to guard.

Wood, when killed by being separated from its root, is subject to gradual destruction from two causes,—rotting, and the depredations of insects.

Of the rot there are two supposed kinds, as they affect wood, first, in the open air, or secondly, under cover.

The first is that which, in the terms of our premium, Class 7, No. 3, is said to occur to "barn and other outside doors, weather-boarding, gates, stiles, and implements of husbandry:" To which, if there were any need of this minute specification, might have been added posts, rails, paling, water-shoots, and various other objects.

The second is well known under the name of the dry-rot, the cause and prevention of which are the subjects of a premium by the Society of Arts in London.

Animal and vegetable substances possess certain common properties and movements, which constitute what is

* Nicholson, vol. 19, p. 328. From *Papers of the Bath and West of England Society*, vol. 11, p. 226.

called life. When that state ceases, and these properties and motions no longer exist, the bodies become subject to the chemical and mechanical laws of all other matter.

When perfectly dry, and in certain degrees of temperature, both seem to be scarcely capable of spontaneous decay. On this principle vast quantities of salmon are annually conveyed in a frozen state to London from the north of England and Scotland; and the inhabitants of the still more northern regions constantly preserve their food, by freezing, unchanged through the longest winters. The gelatinous and other soluble parts of animal substances, when extracted by boiling, and kept in a soft moist state, very readily putrify. But if the same matter be dried by a gentle heat, and secluded from moisture and air by being kept in bottles or metallic cases, it will remain very long without decay. This is the theory of that well-known and useful substance, portable soup. In the burning climate of Africa, when it is intended to preserve a dead animal for food, all that is necessary is to cut the muscular parts into thin strips, from which, in a few hours, the heat of the sun exhales all moisture, reducing them to a substance like leather or horn, which proves to be unsusceptible of future decay from putrefaction. So also entire human bodies, buried in the arid sands of those countries, have often been found converted by exhalation and absorption of their natural moisture into a dry hard sort of mummy, incapable of any farther change from the agency of those causes, to which, in such situations, they are exposed.

Similar causes produce the same effects on wood. Even under less rigid circumstances of this kind, as in the roofs and other timber of large buildings, it continues for an astonishing length of time unchanged; witness the timber of that noble edifice, Westminster Hall,

built by Richard II, in 1397; and the more extraordinary instance quoted by Dr. Darwin, in his ingenious work, the Phytologia, of the gates of the old Saint Peter's church, in Rome, which were said to have continued without rotting, from the time of the emperor Constantine to that of pope Eugene IV, a period of eleven hundred years. On the other hand, wood will remain for ages with little change, when continually immersed in water, or even when deeply buried in the earth; as in the piles and buttresses of bridges, and in various morasses. These latter facts seem to show, that, if the access of atmospherical air is not necessary to the decay of wood, it is, at least, highly conducive to it.

In posts fixed in the ground and exposed to the weather, we constantly find that part soonest decay, which is just above or within the ground. So also where there is an accidental hole in an exposed surface, or any artificial cavity, as in a mortice and tenon, or the part where pales nearly touch the rails on which they are nailed, there the wood universally begins first to moulder away. The same thing happens with regard to horizontal rails themselves, which, when made of the same materials, rot much sooner than the pales which they support. These facts are very easily explained. They clearly show, that the great cause of decay is the constant action of water aided by air, which most affects those points, where it is most retained, but has less operation, where, as in the perpendicular pales, it chiefly runs off by its own gravity, so that the little which remains is easily and quickly abstracted by the co-operating power of the sun and wind.

The change which I am describing is the consequence of putrefactive fermentation; a chemical operation, in which the component parts of the wood form new combinations among themselves, and with the water which is essential to the process. The precise nature of these

new compounds has not been ascertained; but, so far as they are known, they consist of certain gases, or species of air, which fly off, and leave behind a powder, consisting chiefly of carbon or charcoal, and the earth which entered into the original composition of the wood.

Beside this chemical change depending on water, that substance tends to destroy wood exposed to the open air by a mechanical operation. Every farmer is acquainted with the power of winter in mouldering down the earth of his fallows. It is equally well known, that porous freestone splits and shivers during severe winters. These effects are produced by frost, which, acting on the water in the pores or interstices of these substances, expands it by conversion into ice, and thus bursts the minute cells in which it was contained. There can be no doubt, that a similar operation takes place to a certain extent in exposed wood, and thus in some degree promotes its destruction.

It appears, then, that the contact of water and air are the chief causes of the decay of wood. If, therefore, any means can be devised, by which the access of moisture and air can be prevented, the wood is so far secure against decay. This principle may be illustrated by supposing a cylinder of dry wood to be placed in a glass tube or case, which it exactly fills, and the two ends of which are, as it is called, hermetically sealed, that is, entirely closed by uniting the melted sides of each end of the tube. Who will doubt that such a piece of wood might remain in the open air a thousand years unchanged? Or let us take a still more apposite illustration of this fact; that of amber, a native bitumen, or resin, in which a variety of small flies, filaments of vegetables, and others of the most fragile substances are seen imbedded, having been preserved from decay much longer probably than a thousand years, and with no apparent tendency to change

for ten times that period. Let us see then if we cannot, by the exclusion of moisture and air, find means of virtually placing our timber in a case of glass or amber.

With this view, various expedients have been employed, of which the most common is covering the surface with paint; which is oil mixed with some substance capable of giving it the colour which we desire. It is well known, that several of the oils, as those of linseed, hempseed, &c. become dry when thinly spread on any hard substance. The drying quality is much assisted by their being previously boiled with certain metallic oxides, more especially that of lead, litharge. The crust so formed is with difficulty penetrated by moisture or air. For this purpose drying oil is spread on silk or linen, in the manufacture of umbrellas; and will tolerably well succeed in confining hydrogen gas, or inflammable air, in the construction of air-balloons. Hence we see the mode in which the application of paint on wood serves to defend it against the causes of destruction.

When paint is employed within doors, it is customary to add to the oil, beside the colouring matter, some essential oil of turpentine, which not only makes it dry more readily, but, by giving it greater tenuity, causes it to flow more freely from the brush, and therefore to go farther in the work. For the same purposes I observe it forms a part of the paint used on wood and iron work in the open air; but, as it appears to me, most improperly: For I have remarked that on rubbing wood painted white, and long exposed to the weather, the white lead has come off in a dry powder like whiting; as if the vehicle which glued it to the wood had been decomposed and lost, leaving only the pigment behind: And I have been much inclined to suspect, that this has arisen from the oil having been too much *opened*, as the workmen call it, or having its thickness and tenacity too much diminished by a su-

perabundance of the oil of turpentine. In this state it may, in various ways, be more readily acted on by water and air. We know, that the properties of what are called unctuous or fat oils are much changed by the admixture of the volatile or essential oils. On this principle we succeed in getting grease out of woollen cloths by oil of turpentine; but whether the same change is produced on the drying oils, I have not learned.

It appears, then, that these drying oils either by themselves, or boiled with metallic oxides, will form a varnish on wood; but it may be questioned how far the colouring matters, with which they are usually mixed, contribute to increase their preservative power. I do not, however, deny, that they may be serviceable in this and other views. They might be supposed to enable the oil to lay firmer hold, as it were, on the wood; and they may serve to increase the thickness of the defensive covering. The first of these points is of some importance; for we observe that the paint on street doors, which is become thick by frequent incrustation, is apt, from the strong influence of the summer's sun, to separate from the polished wood beneath, and rise in large blisters; probably in consequence of a greater expansion in the crust itself than in the subjacent wood. Here, therefore, the colouring matter of the paint fails to produce the desired effect; and as to the second end, or that of increasing the thickness of the covering, that may, probably, be much more effectually accomplished than by the mere addition of pigments, some of which are capable of chemical decomposition, and all are costly. This purpose an ingenious artist has of late attempted to answer, by recommending an admixture of road-dust; and for that and other means of reducing the price of paints, has obtained a premium from the London Society of Arts. However just the general principle in this case may be, the application is

somewhat unphilosophical; unless it shall be found, which will scarcely be admitted, that dust of every chemical and mechanical quality will equally or sufficiently answer the intended purpose.

Some material of this kind, selected with greater precision, may however undoubtedly be useful; and none I think promises more fairly than siliceous or flinty sand, which, so far as we know, is absolutely indestructible, and which may be easily procured from the sea-shore, and from the currents of the clear rivers and roads in Berkshire and other counties abounding with siliceous stones. Sand from the sea must first be cleared from all saline impregnations by washing in several waters; and any sand may be obtained of the fineness desired, by mixing it with water in a tub, and after having stirred the whole well together, pouring out, in a longer or shorter time, the muddy water, from which the sand will settle by its own gravity, in a state fit for use when dried.

More than thirty years ago this subject presented itself to my mind, on seeing some water-shoots, which had been pitched and painted in the common way, taken down in a state of complete rottenness. I had read that charcoal, buried in the moist earth, had come down to us perfectly sound from the times of the Romans; and that posts long withstood the same moisture, if the part intended to be put into the ground was charred all round to a certain depth. Impressed with these facts, I determined to try an artificial coat of charcoal; and when new water-shoots were constructed, I strongly and carefully rubbed them with a coat of drying oil, which I immediately dredged all over with a thick layer of charcoal finely powdered, and contained in a muslin bag. After two or three days, when the oil was thoroughly dried, and firmly retained the greatest part of the charcoal, I

brushed off what was loose, and over that which adhered I applied a coat of common lead-coloured paint, and a few days after, a second. The whole became a firm and solid crust; after which the shoots were put into their places, and being examined many years afterward, appeared perfectly sound. Any other colour would probably have succeeded equally well with that which I employed. I do not think that lamp black, which is a pure species of charcoal, would have answered the purpose of forming a thick defensive covering so well as the grosser charcoal which I used. But whatever sort of charcoal is employed, it ought either to be fresh made, or heated again in close vessels, so as to expel the water which it greedily attracts from the air.

To all compositions formed from drying vegetable oils there is this objection; that however well they may answer the end proposed, they are too dear for that great consumption, which is usually required for outside work. For this and other reasons, various other substances have been employed for the same purpose.

Of these the most common is pitch, which is well known to be the resinous matter melted by heat out of the pine tribe of trees in form of tar, and afterwards hardened by evaporation. It is applied hot, and when cold, makes a moderately hard varnish. It does not however appear, in fact, to answer the purpose so well as might have been expected. The sun at first melts it, so that it runs off in drops, or adheres to every thing which touches it; and the united influence of air and water seems to make it brittle and powdery like resin. Experience, therefore, shows it to be of little value. Neither is it probable that its powers would be much improved by admixture with charcoal, sand, or other similar substances. Many members of this Society may recollect its application twenty years ago on the red-deal shingled roofs of part of our

market. In this case it was used hot, mixed with Spanish brown, and hardened by sand sifted over it with a sieve; notwithstanding which it seems to have left the wood like the unmixed pitch, and, though frequently renewed, has not prevented the necessity of various repairs within these last five years. The original boards are now every where more or less in a state of decay.

The bituminous substance melted by heat out of coal, and commonly called coal tar, has been strongly recommended for this purpose by that ingenious philosopher Lord Dundonald. I have tried it largely and unsuccessfully, though perhaps not fairly; for the workmen whom I employed, in order to make it work more easily, added to it oil of turpentine, which certainly diminished its durability by rendering it more miscible with water. I am however inclined to believe, that no substance of this kind, used by itself, will become sufficiently dry and hard to resist the influence of the weather.

As animal oils are considerably cheaper than those expressed from vegetables, attempts have been made to communicate to them a drying quality. This has been effected by dissolving in them while hot various substances capable of being melted, in such a portion that the whole mass would become dry and hard when cold. Bees' wax, resin, and brimstone are found to have this property. Some of them, when united with drying oil, have long been employed for making boots and shoes water-proof, or impervious to moisture.* But they will

* For this purpose there is the following receipt by Mr. Barker, in sir John Hawkins's edition of that entertaining work, Isaac Walton's Complete Angler: fourth edition, page 223. "Take a pint of linseed oil, with half a pound of mutton suet, six or eight ounces of bees' wax, and half a pennyworth of resin. Boil all this in a pipkin together; so let it cool till it be milk-warm. Then take a little hair-brush, and lay it on your new boots; but it is best that this stuff be laid on before the boot-maker makes the boots; then brush them once over with it after they come from him. As for old boots, you must lay it on when your boots be dry."

also succeed when mixed with train oil, which is obtained from the blubber of the whale. In the second volume of the Memoirs of this Society, printed in the year 1783, there is the following receipt. "Melt twelve ounces of resin in an iron pot or kettle; add three gallons of train oil and three or four rolls of brimstone; and when the resin and brimstone are melted and become thin, add as much Spanish brown, or red or yellow ochre, or any colour you want, first ground fine with some of the oil, as will give the whole as deep a shade as you like. Then lay it on with a brush as hot and thin as you can. Some days after the first coat is dried, give it a second. It will preserve plank for ages, and keep the weather from driving through brick-work." Page 114.

This composition I tried about eighteen years ago on some elm paling, substituting for the colouring matter one or two coats of common white paint for the sake of the appearance. This paling appears to me to be in every part of it, which was covered, as sound as when it was first put up.

As compositions of the resinous kind are apt to crack and become powdery, like the varnish of carriages, by exposure to weather, it is not improbable, that this effect may be in some measure counteracted by the mixture of a small proportion of bees' wax. Such a compound I have used, but in the quantity of eight ounces to the gallon found it too slow in drying, and capable of being easily scraped off with the nail. Wax is also at this time very scarce and dear.

All the substances contained in these mixtures are capable of perfect incorporation with each other by heat, and when separately exposed, are with great difficulty acted on by water or air in any heat which occurs in our climate. They should be applied hot with a common painter's brush on the wood which is previously very

dry, so as to sink deeply into its pores; and though at first they are apparently somewhat greasy when cold, yet after some days they make a firm varnish, which does not come off on rubbing. When it is required to give beauty to the work, colouring matters may either be added to the mixture, or afterward applied over it in form of common paint. Two coats of the composition should always be given; and in all compound machinery, the separate parts should be so varnished before they are put together; after which it will be prudent to give a third coating to the joints, or to any other part which is peculiarly exposed to the action of moisture, such as water-shoots, flood gates, the beds of carts, the tops of posts and rails, and all timber which is near or within the ground. Each coat should be dry before the parts are joined, or the last coat applied.

These compositions are equally efficacious in keeping iron from decay by rusting. They might also be very advantageously employed in rendering water-tight the plaister which is used to case the outside of the arches of vaults unsheltered by roofs, provided the mortar were made perfectly dry, and the covering of the arch brought up to an angle, instead of making it follow the form of the arch in an elipse or the segment of a circle.

It is necessary to mention, that compositions made of hot oil should for the sake of security be heated in metallic or glazed earthen vessels in the open air. For whenever oil is brought to the boiling point, or 600° of Fahrenheit's thermometer, the vapour immediately catches fire, although not in contact with any flame; and though a lower degree of temperature than that of boiling should be used in this process, it is not always practicable either exactly to regulate the heat, or to prevent the overflowing of the materials, in either of which cases, were

the melting performed in a house, the most fatal accidents might follow.

The following is the proportion of the above ingredients, and the mode of mixing them, which I should recommend.

Take twelve ounces of resin, and eight ounces of roll brimstone, each coarsely powdered, and three gallons of train-oil. Heat them slowly, gradually adding four ounces of bees'-wax, cut into small bits. Frequently stir the liquor, which, as soon as the solid ingredients are dissolved, will be fit for use. What remains unused will become solid on cooling, and may be re-melted on subsequent occasions.

If the addition of charcoal powder or siliceous sand contributes to the durability of drying oil, it may probably have a similar effect on this composition; but whether it may be best to mix them with the ingredients, or apply them afterward, I cannot from experience tell. In the latter case, the powder should be sifted on, while the first coat of the composition is still hot; and, after some days, when that is dry, should have a brush gently passed over it, in order to remove all the particles which do not adhere; after which other coats of the composition may be applied, as before directed.

This is all which occurs to me as to the mode of preserving wood when exposed to the weather.

(*To be concluded in our next number.*)

NO. 62.

Description of the Method employed at Astracan for making grained Parchment or Shagreen. By Professor PALLAS.*

THE process for preparing shagreen is a very old oriental invention, not practised in Europe, and which,

* Tilloch, vol. 6, p. 217.

as far as I know, has never yet been described; though Basil Valentin* is pretty right in what he says of it in general. It is one of those arts of the East, which, like that of the Turkey dye for cotton, the preparation of Russia leather, isinglass, &c. have remained unknown and unemployed, not because they are kept secrets, but because none of the European travellers ever took the trouble to learn them, and because the materials used are not so common and so cheap in Europe. It may be of some utility, therefore, if I here give a circumstantial description of this art as it is practised at Astracan by the Tartars and Armenians, especially as the method of these people is perfectly similar to that used in Turkey, Persia, and various parts of Bucharia, and as the shagreen-makers of Astracan acknowledge that they obtained the process originally from Persia.

All kinds of horses' or asses' skin, which have been dressed in such a manner as to appear grained, are by the Tartars called *sauwer*, by the Persians *sogre*, and by the Turks *sagri*, from which the Europeans have made *shagreen* or *chagrin*. The Tartars who reside at Astracan, with a few of the Armenians of that city, are the only people in the Russian empire acquainted with the art of making shagreen. Those who follow this occupation not only gain considerable profit by the sale of their production to the Tartars of Cuban, Astracan, and Casan, who ornament with it their Turkey leather boots, slippers, and other articles made of leather; but they derive considerable advantage from the great sale of horses' hides, which have undergone no other process than that of being scraped clean, and of which several thousands are annually exported, at the rate of from seventy-five to

* See *M. B. Valentini Museum Museorum oder Vollfländige Schaubühne aller materiallien und specereyen*, p. 439.

eighty-five roubles per hundred, to Persia, where there is a scarcity of such hides, and from which the greater part of the shagreen manufactured in that country is prepared. The hind part only of the hide, however, which is cut out in the form of a crescent about a Russian ell and a half in length across the loins, and a short ell in breadth along the back, can properly be employed for shagreen. The remaining part, as is proved by experience, is improper for that purpose, and is therefore rejected.

The preparation of the skins, after being cut into the above form, is as follows:—They are deposited in a tub filled with pure water, and suffered to remain there for several days, till they are thoroughly soaked, and the hair has dropped off. They are then taken from the tub, one by one, extended on boards placed in an oblique direction against a wall, the corners of them, which reach beyond the edges of the board, being made fast, and the hair with the epidermis is then scraped off with a blunt iron scraper called *urak*. The skins thus cleaned are again put in pure water to soak. When all the skins have undergone this part of the process, they are taken from the water a second time, spread out one after the other as before, and the flesh side is scraped with the same kind of instrument. They are carefully cleaned also on the hair side, so that nothing remains but the pure fibrous tissue, which serves for making parchment, consisting of coats of white medullary fibres, and which has a resemblance to a swine's bladder softened in water.

After this preparation, the workmen take a certain kind of frames called *pälzi*, made of a straight and a semi-circular piece of wood, having nearly the same form as the skins. On these the skins are extended in as smooth and even a manner as possible by means of cords; and during the operation of extending them they

are several times besprinkled with water, that no part of them may be dry, and occasion an unequal tension. After they have been all extended on the frames, they are again moistened, and carried into the house, where the frames are deposited close to each other on the floor with the flesh side of the skin next the ground. The upper side is then thickly bestrewed with the black exceedingly smooth and hard seeds of a kind of goose-foot, (*chenopodium album,*)* which the Tartars call *alabuta*, and which grows in abundance, to about the height of a man, near the gardens and farms on the south side of the Volga; and that they may make a strong impression on the skins, a piece of felt is spread over them, and the seeds are trod down with the feet, by which means they are deeply imprinted into the soft skins. The frames, without shaking the seeds, are then carried out into the open air, and placed in a reclining position against a wall to dry, the side covered with the seeds being next the wall, in order that it may be sheltered from the sun. In this state the skins must be left several days to dry in the sun, until no appearance of moisture is observed in them; when they are fit to be taken from the frames. When the impressed seeds are beat off from the hair side, it appears full of indentations or inequalities, and has acquired that impression which is to produce the grain of the shagreen, after the skins have been subjected to the last smoothing or scraping, and have been dipped in a ley, which will be mentioned hereafter, before they receive the dye.

The operation of smoothing is performed on an inclined bench or board, which is furnished with an iron

* This chenopodium is often used as food by the German colonists on the Volga, on account of the frequent failure of their crops. They employ it either as a substitute for greens, or pound the seeds, and, with the addition of a little meal, form them into bread.

hook, and is covered with thick felt or sheep's wool on which the dry skin may gently rest. The skin is suspended in the middle of the bench or board to its iron hook, by means of one of the holes made in the edge of the skin for extending it in its frame as before mentioned; and a cord, having at its extremity a stone or a weight, is attached to each end of the skin, to keep it in its position while under the hands of the workman. It is then subjected to the operation of smoothing and scraping by means of two different instruments. The first used for this purpose, called by the Tartars *tokar*, is a piece of sharp iron bent like a hook, with which the surface of the shagreen is pretty closely scraped to remove all the projecting inequalities. This operation, on account of the corneous hardness of the dry skin, is attended with some difficulty; and great caution is at the same time required that too much of the impression of the *alabuta* seed be not destroyed, which might be the case if the iron were kept too sharp. As the iron, however, is pretty blunt, which occasions inequalities on the shagreen, this inconvenience must afterwards be remedied by means of a sharp scraping-iron or *urak*, by which the surface acquires a perfect uniformity, and only faint impressions of the *alabuta* seed then remain, and such as the workman wishes. After all these operations, the shagreen is again put into water, partly to make it pliable, and partly to raise the grain. As the seeds occasion indentations in the surface of the skin, the intermediate spaces, by the operations of smoothing and scraping, lose some part of their projecting substance; but the points which have been depressed, and which have lost none of their substance, now swell up above the scraped parts, and thus form the grain of the shagreen. To produce this effect, the skins are left to soak in water for twenty-four hours;

after which they are immersed several times in a strong warm ley, obtained, by boiling, from a strong alkaline earth named *schora*, which is found in great abundance in the neighbourhood of Astracan. When the skins have been taken from this ley, they are piled up, while warm, on each other, and suffered to remain in that state several hours; by which means they swell, and become soft. They are then left twenty-four hours in a moderately strong pickle of common salt, which renders them exceedingly white and beautiful, and fit for receiving any colour. The colour most usual for these skins is a sea-green; but old experienced workmen can dye them blue, red, or black, and even make white shagreen.

For the green colour nothing is necessary but filings of copper and sal-ammoniac. Sal-ammoniac is dissolved in water till the water is completely saturated; and the shagreen skins, still moist, after being taken from the pickle, are washed over with the solution on the ungrained flesh side, and when well moistened a thick layer of copper filings is strewed over them: the skins are then folded double, so that the side covered with the filings is innermost. Each skin is then rolled up in a piece of felt; the rolls are all ranged together in proper order, and they are pressed down in an uniform manner by some heavy bodies placed over them, under which they remain twenty-four hours. During that period the solution of sal-ammoniac dissolves a quantity of the cupreous particles sufficient to penetrate the skin and to give it a sea-green colour. If the first application be not sufficient, the process is repeated in the same manner; after which the skins are spread out and dried.

For the blue dye, indigo is used. About two pounds of it, reduced to a fine powder, are put into a kettle; cold water is poured over it, and the mixture is stirred round

till the colour begins to be dissolved. Five pounds of pounded *alakar*, which is a kind of barilla or crude soda, prepared by the Armenians and Calmucs, is then dissolved in it, with two pounds of lime* and a pound of pure honey, and the whole is kept several days in the sun, and during that time frequently stirred round. The skins intended to be dyed blue must be moistened only in the natrous ley *schora*, but not in the salt brine. When still moist, they are folded up and sewed together at the edge, the flesh side being innermost, and the shagreened hair side outwards; after which they are dipped three times in the remains of an exhausted kettle of the same die, the superfluous dye being each time expressed; and after this process they are dipped in the fresh dye prepared as above, which must not be expressed. The skins are then hung up in the shade to dry; after which they are cleaned and paired at the edges.

For black shagreen, gall-nuts and vitriol are employed in the following manner:—The skins, moist from the pickle, are thickly bestrewed with finely pulverised gall-nuts. They are then folded together, and laid over each other for twenty-four hours. A new ley, of bitter saline earth or *schora*, is in the mean time prepared, and poured hot into small troughs. In this ley each skin is several times dipped; after which they are again bestrewed with pounded gall-nuts, and placed in heaps for a certain period, that the galls may thoroughly penetrate them, and they are dried and beat, to free them from the dust of the galls. When this is done, they are rubbed over, on the shagreen side, with melted sheep's tallow, and exposed a little in the sun, that they may imbibe the grease. The

* Quick-lime is probably meant here, which, by taking up the carbonic acid of the alkali, and thereby rendering it caustic, will enable it to effect a mechanical solution, or rather an impalpable comminution, of the indigo.—TILLOCH.

shagreen-makers are accustomed also to roll up each skin separately, and to press or squeeze it with their hands against some hard substance, in order to promote the absorption of the tallow. The superfluous particles are removed by means of a blunt wooden scraper (*urak*); and when this process is finished, and the skins have lain some time, a sufficient quantity of vitriol of iron is dissolved in water, with which the shagreen is moistened on both sides, and by this operation it acquires a beautiful black dye. It is then dressed at the edges, and in other places where there are any blemishes.

To obtain white shagreen, the skins must first be moistened, on the shagreen side, with a strong solution of alum. When the skin has imbibed this liquor, it is daubed over on both sides with a paste made of flour, which is suffered to dry. The paste is then washed off with alum water, and the skin is placed in the sun till it is completely dry. As soon as it is dry, it is gently besmeared with pure melted sheep's tallow, which it is suffered to imbibe in the sun; and, to promote the effect, it is pressed and worked with the hands. The skins are then fastened in succession to the before-mentioned bench, where warm water is poured over them, and the superfluous fat is scraped off with a blunt wooden instrument. In the last operation the warm water is of great service. In this manner shagreen perfectly white is obtained, and nothing remains but to pair the edges and dress it.

But this white shagreen is not intended so much for remaining in that state as for receiving a dark red dye, because, by the above previous process, the colour becomes much more perfect. The skins destined for a red colour must not be immersed first in ley of bitter salt earth, (*schora*,) and then in pickle, but, after they have been

whitened, must be left to soak in the pickle for twenty-four hours. The dye is prepared from cochineal, which the Tartars call *kirmitz*. About a pound of the dried herb *tschagann*, which grows in great abundance in the neighbourhood of Astracan, and is a kind of soda-plant or kali, (*salsola ericoides*,)* is boiled a full hour in a kettle containing about four common pailfuils of water; by which means the water acquires a greenish colour. The herb is then taken out, and about half a pound of pounded cochineal is put into the kettle, and the liquor is left to boil a full hour, care being taken to stir it that it may not run over. About fifteen or twenty drams of a substance which the dyers call *lüter* (orchilla) is added, and when the liquor has been boiled for some time longer the kettle is removed from the fire. The skins taken from the pickle are then placed over each other in troughs, and the dye-liquor is poured over them four different times, and rubbed into them with the hands, that the colour may be equally imbibed and diffused. The liquor each time is expressed; after which they are fit for being dried. Skins prepared in this manner are sold at a much dearer rate than any of the other kinds.

* The beautiful red Turkey leather is dyed with cochineal prepared in the same manner. Professor Gmelin, junior, in the second part of his Travels through Russia, explains the herb *tschagann* by *artemisia annua*, having doubtless been deceived by the appearance the plant acquires after it has been dried. Besides, this *artemisia* is found only in the middle of Siberia, and never on the west side of the Irtisch.

No. 53.

List of American Patents.

(Continued from page 240.)

1808.

Asahel E. Paine, July 1, a washing machine.

Dyer Cleveland, July 7, improvement in the churn.

Robert Ramsey, July 9, a pressing and boring machine.

Samuel Parker, July 9, improvement in tanning.

Samuel Parker, July 9, improvement in currying and finishing leather.

Abel Brewster, July 11, the universal vitriolic test, for making all kind of bank or other bills.

Enos Trescott, July 11, a washing machine.

Theron Henry, July 11, a washing machine.

Thomas Osgood, July 11, a washing machine.

Ebenezer Lister, July 11, a washing machine.

Dudley Loomis and Ira Millington, July 11, a washing machine.

Dyer Cleveland, July 11, improvement in the churn.

Erastus Townsend, July 12, improvement in churns.

Isaac Cobb, July 12, machine for splitting skins.

Jonathan Lucas, junior, July 12, machine for cleaning rice.

Eli Barnum and Benjamin Brooks, July 13, improvement in distilling.

Philip Apple, July 13, improvement in funnels for filling vessels with fluids.

Uzziel Geer, July 18, improvement in the wind mill.

Samuel Bartlett, July 19, improvement in rolling tub mills.

Martin Tullar, July 29, machine for shaving and splitting leather.

John Bolton, Aug. 2, improvement in churns.

Elihu Hotchkiss, Aug. 2, machine for cntting straw.

Obadiah Seeley, Aug. 6, improvement in the spinning wheel.

Jacob Coon, Aug. 6, machine for making wheels of all sorts.

John Thomas Ricketts, Aug. 8, machine for hulling and cleaning rice, and for many other purposes.

William Smith, Aug. 12, machine for elevating water at mills, &c.

James Finley and John Templeman, Aug. 16, improvement in chain bridges.

Joshua Cone, Aug. 26, improvement in carriage springs.

William Barker, Aug. 26, machine for raising water.

Stephen W. Dana, Aug. 30, a washing machine.

Stephen W. Dana, Aug. 30, improvement in wheel carriages.

Stephen Winchester, Aug. 31, a washing and churning machine.

Samuel Prince, Aug. 31, machine for pressing straw or chip hats, &c.

Samuel Gragg, Aug. 31, an elastic chair.

Gersham Cobb, Sept. 7, a geometrical interest table.

Garry Bishop, Sept. 7, a washing and churning machine.

Dan Parmele, Sept. 8, a rocking churn.

Asaph Chandler and Silas Shepard, Sept. 11, machine for heading nails.

Benjamin Atwell, Sept. 19, a fanning and winnowing mill.

Isaiah Jennings, Sept. 20, a pump bellows for furnaces and forges.

Marcus B. Parmelee, Sept, 21, a ratchet wheel.

Asa Frost, Sept. 21. improvement in making brick.

Paul Pilsbury, Sept. 22, machine for grinding bark, for tanning, &c.

William Burtis, Oct. 3, improvement in the taylor's bench.

Elisha Calendar, Oct. 3, improvement in lightning rods.

Thomas Bruff, Oct. 5, machine for making balls and shot by pressure.

John P. Lherbette, Oct. 7, improvement in military knapsacks.

Samuel Moon, junior, Oct. 24, improvement in churns.

John West, Oct. 27, improvement in ovens.

Jacob Cist, Oct. 28, a black pigment or mineral black for printing ink, or painting in oil or water.

Daniel Pettibone, Oct. 28, a rarefying air stove for warming rooms, &c.

Charles Cooper, Nov. 4, improvement in looms for weaving of every kind.

Randall Wallis, Nov. 9, machine for separating grain and seeds from straw, &c.

Simon B. Willard, Nov. 17, machine for scrubbing or scouring floors of houses, &c.

Eli Fourestier, Nov. 17, improvement in refining lamp oil.

Stedman Adams, Nov. 21, improvement in stills and rotary steam engines.

Samuel Chamberlain, Nov. 21, improvement in boots and shoes.

Joel Farnham, Nov. 23, improvement in Macomb's horizontal, re-acting water wheel.

Richard B. Chenoweth, Nov. 25, improvement in ploughs.

Stephen Mirick, Nov. 30, a rolling wheel on an inclined shaft.

John Devotie, Dec. 5, a churn and washing machine.

William Brown, Dec. 8, a mill for breaking plaister of paris, &c.

Rufus W. Adams, Dec. 8, improvement in grist mills.

Benjamin Giddins, Dec. 10, an elastic trace and brace, by connected springs.

Stephen Couch and Asa Towne, Dec. 10, machine for rolling and plating iron, and cutting nails.

Luther Jones, Dec. 10, improvement in the churn.

Isaac Bennitt, Dec. 12, improvement in still tubs.

Robert Nicholson and Thomas Nicholson, Dec. 13, machine for dressing shingles.

James P. Parke, Dec. 19, an alarm bell for fire engines.

Levi Martin, Dec. 19, improvement in the cheese press.

Anos Gunn, Dec. 19, a double boiler for distilling.

Willard Badger, Dec. 26, improvement in casting pipes or tubes.

Joseph Henderson, Dec. 26, mode of suspending or hanging pleasure carriages, &c.

Hezekiah Dickerman, Dec. 27, improvement in the cheese press.

John Dimond, Dec. 28, improvement in distillation.

Hazen Erwin, Dec. 28, a geer press for pressing cheese, &c.

George Rogers, Dec. 31, the vegetable pulmonic detergent.

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PROSPECTUS

OF

THE EMPORIUM

OF

ARTS AND SCIENCES.

(NEW SERIES)

THE Emporium hitherto published, having been relinquished by its Editor and Publisher, I have undertaken to continue it under the same title; and the public will of course expect that I should give some account of the plan on which it is meant hereafter to be conducted.

I had prepared a volume of papers on manufacturing processes, which the publishers of the present work were to have published separately, had not the new series of the Emporium been undertaken. The matter I had meant for that work, I shall now employ upon this; and I will make, if I can, the Emporium a repository of papers on manufactures, that shall be worth preserving. They will consist of a series of essays drawn up and arranged by myself, but with the assistance of every thing I can find to the purpose in foreign publications. I have long been anxious to compose and to compile a work of

this description, that shall remain a classic book on the subject, and I will endeavour to do it now.

In treating of the various subjects, it will be fair to give notice, that I will not condescend to make this a work of mere amusement, for the purpose of sale—one that shall suffice merely, under the show of science, to enable the reader to trifle away an hour, and to skim the surface of a great many subjects for the purpose of superficial and conversation knowledge. Many pages of this work to a general reader will be very dull; but it will be my fault if they are not useful to those who read for improvement.

I do not propose in the manufacturing papers I shall present, whether of my own or of others, greatly to instruct a manufacturer—a man who knows his business; or, by a sudden miracle, to form a skilful manufacturer by the perusal of a few theoretical pages. I know too well, from my own experience, that this cannot be done; and, I can easily conceive, with what contempt a practical man must read a great portion of the papers that pretend to give knowledge of real processes, among the French and English publications of this description. What innumerable instructions on the art of dying, for instance! yet I can venture to say, that hardly one paper in fifty contains either the processes of practice, or any kind of applicable information. Still the collectors of these facts are of great use in society: if they fail, it is because they are not themselves manufacturers; and because all manufacturers are secret-mongers, who live by their processes, and who do not choose to expose them to all the world. But many hints of importance are thus thrown out to those whose previous knowledge enables them to convert such hints to useful purposes: many lights are thus thrown on the rationale of manufacturing processes, which will enable a practical man better to

understand the nature and effect of the processes he has been accustomed to use, and to correct and vary them without depending upon chance whether he is wrong or right.

Moreover, there is hardly a manufacture that is not capable, in some way or other, of improving and throwing light upon some other manufacture, in appearance widely different. The art of the watchmaker has very greatly contributed to the perfection of the cotton machines. Scheele's discovery of the oxy-muriatic acid, has added one fourth to the capital of all the bleachers and callico-printers of Great Britain; the theory of Lavoisier gave rise to D'Argand's lamp; the experiments on the distillation of pit coal for coal tar, promise fair to furnish a better, a brighter, a safer, a cheaper light, than any other known combustible; the barometer has greatly improved the steam engine, and the water blast of the British iron works; the application of steam has, in England, changed the face of the dye house, the distillery, and the soap manufactory; it has improved the cooking apparatus of the kitchen, it has warmed the public buildings, it has been converted into a medicinal application of great importance,—while the steam engine itself has given incalculable force and facility to the manufactures of the kingdom, nearly without exception.

In almost all this knowledge, and in this application of it, as in a thousand similar instances that might be added to this short list, our own country is yet behindhand, and has yet to learn.

Moreover, papers that would be considered as of no great moment in that manufacturing country, will be of use in this. In the infancy of our manufacturing establishments, the conductors of them have to feel their path, to tread cautiously, to reflect anxiously, and lights be-

come important in the midst of darkness that would be unseen or unnoticed in the blaze of day.

Having been much occupied in chemical pursuits, and much conversant with manufactures and manufacturers, I feel myself as well qualified as most men, to select such information as in some way or other will be worth attention, but which also will require, as I hope it will generally repay, attention. Making this a stock-book for papers of value on the manufactures and the arts, I must be greatly indebted to other publications, and frequently to publications well known: frequently too, I shall have to republish in pursuit of my plan, what may have been already published by myself or others. If I make this work, as I mean to do, *the repository* for this kind of information, I must do so. No man can pretend to be original throughout a work on this extensive plan; it will be well conducted if he select judiciously.

Whether it be worth while to *encourage* manufactures in this country, or to turn aside a part of the capital from the immediate employment of agriculture, is a question of great moment. All bounties and protecting duties, are taxes upon the rest of the community, in support of that employment of capital which, without them, would be injudicious and unproductive. While so much land remains uncultivated, there can be no want of opportunities of employing capital in America. Generally speaking also, the interference of government is sadly misplaced, when it attempts to direct the capitalist what he shall do with his money. *Laissez nous faire*, is the proper reply. Still, there are considerations of great weight with me, in opposition to this general reasoning, that I have never seen urged.

1st. Our population is becoming scattered over such an extent of territory, that the nation is really weakened by it; defence is more difficult and expensive; active

hostility almost impossible; the communication of society, and of course of knowledge, is greatly retarded; many of our citizens are tempted to live in a half savage state; and even the administration of law, and the maintenance of order and necessary subordination, is rendered imperfect, tardy, and expensive.

2dly. Our agriculturists want a *home* market: manufactures would supply it. Agriculture at great distances from seaports, languishes for want of this. Great Britain exhibits an instance of unexampled power and wealth, by means of an agriculture greatly dependent on a system of manufacture: and her agriculture, thus situated, is the best in the world, though still capable of great improvement.

3dly. We are too much dependent upon Great Britain for articles that habit has converted into necessaries. A state of war demands privations that a large portion of our citizens reluctantly submit to. Home manufactures would greatly lessen the evil.

4thly. By means of debts incurred for foreign manufactures, we are almost again become colonists: we are too much under the influence, indirectly, of British merchants and British agents: we are not an independent people. Manufactures among us would tend to correct this, and give a stronger tone of nationality at home. I greatly value the intercourse with that country, of pre-eminent knowledge and energy, but our dependence upon it is often so great, as to be oppressive to ourselves.

5thly. The state of agriculture would improve with the improvement of manufactures, by means of the general spirit of energy and exertion which no where exists in so high a degree as in a manufacturing country; and by the general improvement of machinery, and the demand of raw materials.

6thly. The introduction of manufactures would extend knowledge of all kinds, particularly scientifical. The elements of natural philosophy and of chemistry, now form an indispensable branch of education among the manufacturers of England. They cannot get on without it. They cannot understand or keep pace with the daily improvements of manufacture without scientific knowledge: and scientific knowledge is not insulated; it must rest upon previous learning. The tradesmen of Great Britain, at this day, can furnish more profound thinkers on philosophical subjects, more acute and accurate experimenters, more real philosophers thrice told, than all Europe could furnish a century ago. I wish that were the case here; but it is not so. I fear it is not true, that we are the most enlightened people upon the face of the earth; unless the facility of political declamation be the sole criterion of decision, and the universal test of talent. We should greatly improve, in my opinion, by a little more attention to mathematical and physical science; I would therefore encourage whatever would introduce a general taste for such pursuits.

For these reasons, I think it would be expedient so far to aid the introduction of manufactures in this country, by protecting duties, as to afford a reasonable prospect of safety to the prudent investment of capital, and the industrious pursuit of business, but no bounty to wild speculation, or negligent workmanship.

But I must not forget, that for a book to be useful, it must be saleable. However desirous, therefore, I may be of making this a stock book for papers on the arts and manufactures, I shall not so crowd it with dry detail, and with matter but partially interesting, as to leave no room for miscellaneous information of a more general nature. I shall be glad to introduce notices of our own inventions and improvements, and descriptions of our own

rising manufactures. I shall be very glad to receive and insert articles of this kind, and generally any original paper which I may deem worthy of the public eye. Communications of this description, post paid, to myself or the publishers, Kimber and Richardson, of Philadelphia, will be honestly attended to.

THOMAS COOPER.

Carlisle, February 1813.

CONDITIONS.

THE Emporium of Arts and Sciences will be published, in numbers, every two months, each number containing appropriate and well executed engravings, and upwards of one hundred and fifty pages of letter press. The first number will be published the first of May next.

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